6th ANNUAL QUALITY CONTROL FEATURE ISSUE

OCTOBER, 1953

TOOLING and PRODUCTION

The Magazine of Manufacturing Management

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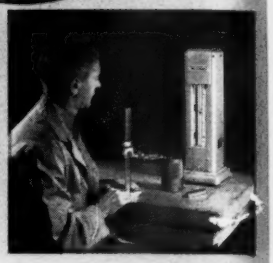
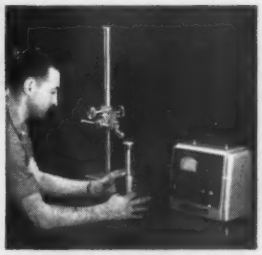


New Sheffield Airetest Indicator—repetitive readings from any direction—ask for a demonstration.

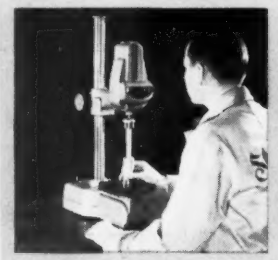
N-6 Electronic Internalchek—checks I. D.'s from .250" to 12"—most widely used of all internal checkers.



Electronic Height Gage—vertical range 18", amplification 1,000 to 1—new toolroom surface plate accuracy.

Electronic Horizontal Externalchek—12" capacity, 1,000/2,000 to 1 amplification. It's new but proved.

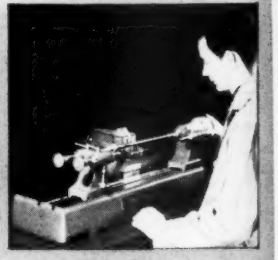
Electronic Leadchek—capacity 36" between centers and up to 10" dia.—more in use than all others of this capacity.



Tool Room Visual Gage—amplifications 500, 1,000 and 2,000 to 1—most versatile and foolproof comparator.

High Amplification Visual Gage—5,000 and 10,000 to 1 amplification—ideal for gage checking in the Tool Room.

Floating Carriage Comparators—diameters and P.D.'s up to 14"—quick, accurate checking of cylindrical work.



Type TS Leadchek-capacity 18" in length, 8" in diameter—checks lead of internal, external and taper threads.

6250

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TOOLING and PRODUCTION

The Magazine of Manufacturing Management

formerly
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TOOL & DIE JOURNAL 1941-51

Vol. XIX—No. 7 October, 1953

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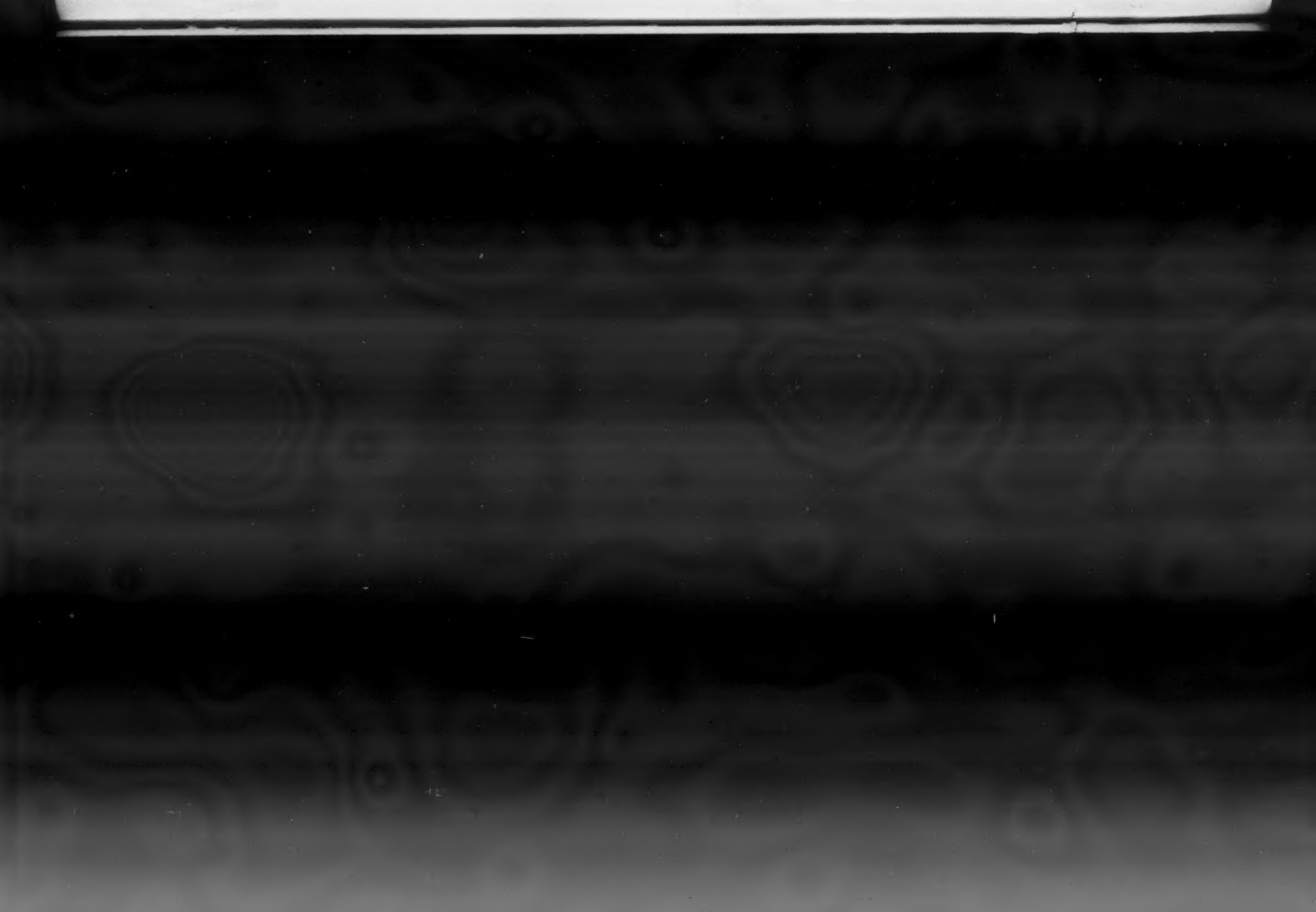

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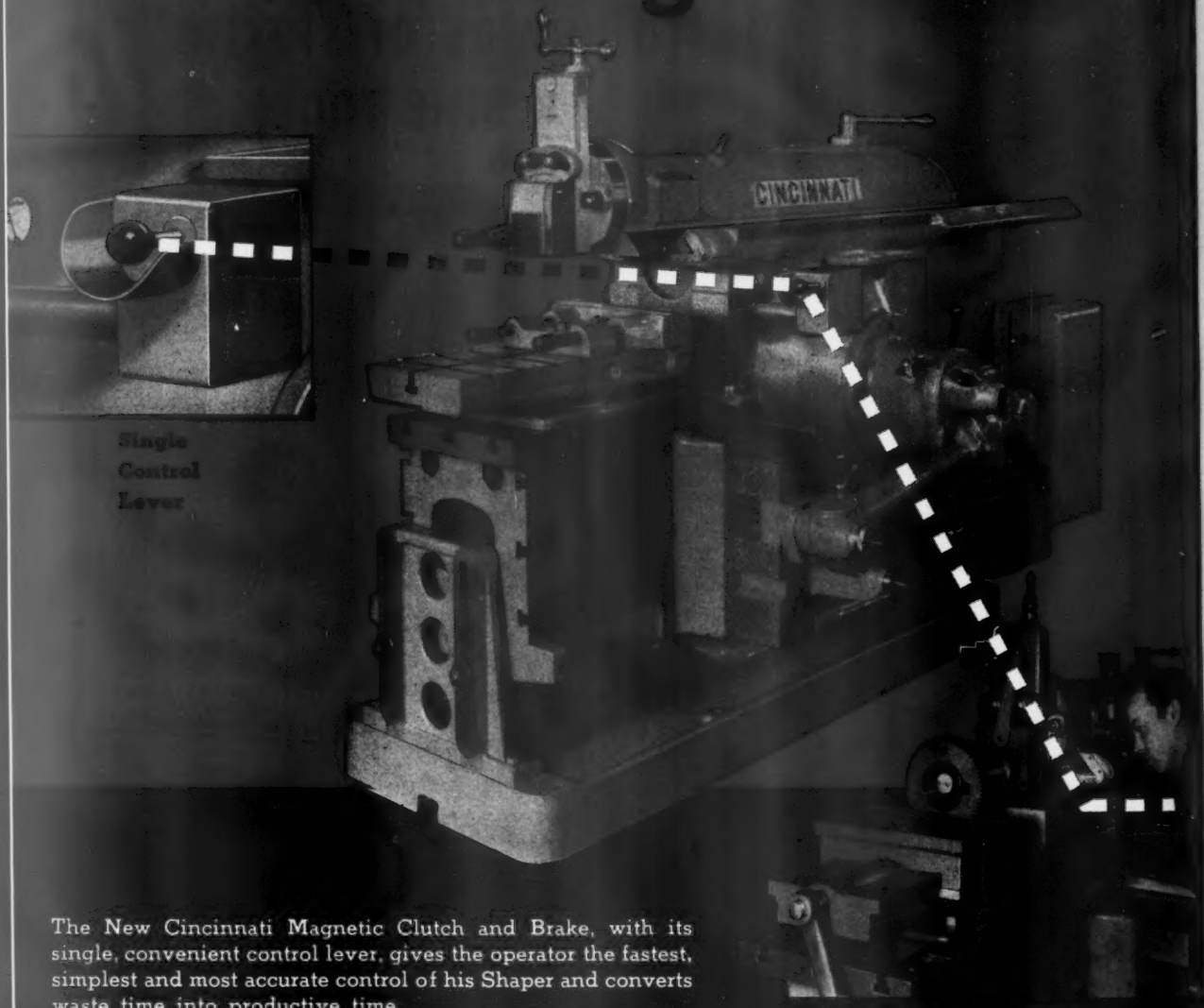

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The New Cincinnati Magnetic Clutch and Brake, with its single, convenient control lever, gives the operator the fastest, simplest and most accurate control of his Shaper and converts waste time into productive time.

This powerful clutch and brake requires no adjustment, and has a long, maintenance-free life.

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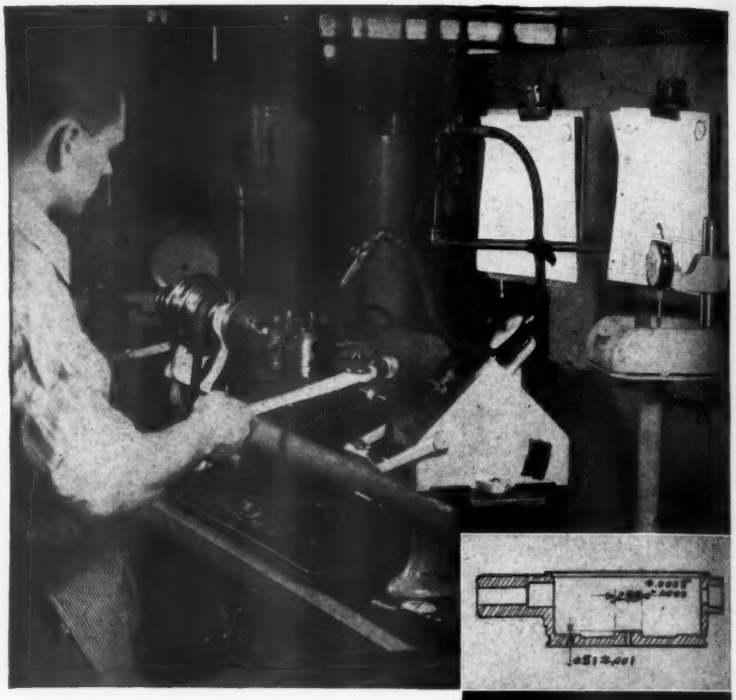

QUALITY CONTROL by STATISTICAL METHODS

Federal first actively supported the application of Dimensional Quality Control by Statistical Methods in 1945. Over 60,000 copies of its booklet, the "Federal Dimensional Quality Control Primer," have been supplied to interested people. Over 1200 men from all over the United States have taken its 5-day course on this subject. And a great many individuals and industrial concerns have received direct assistance in its application.

Today Statistical Control of Dimensions is reaching a more mature consideration and use. No longer is dimensional gaging and control looked upon as a costly overhead. Rather, it is now considered as a scrap and cost saving tool which also assures a better product at a better price.

The right dimensional gages applied at the right places and in the right way are of top importance in the production of parts and products of almost all industry.

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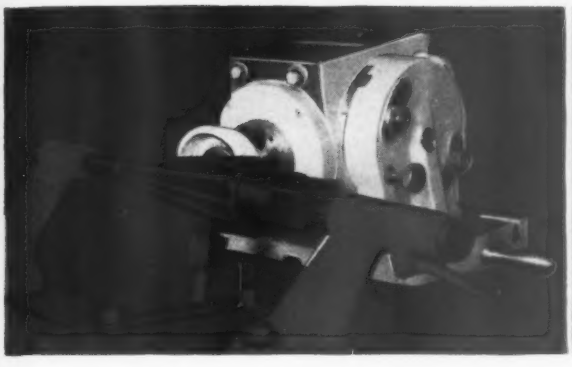

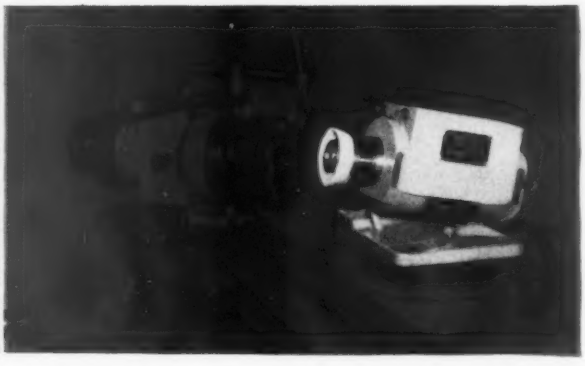

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1. Cup wheels, generally considered best for cutter grinding, can be used for practically all clearance angles on this new head.
2. Cup wheels produce a cutting edge on tools that lasts longer because it is stronger.
3. The tooth rest remains on the center line of the cutter for practically all grinding on centers or in the work head.
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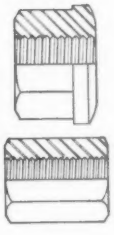

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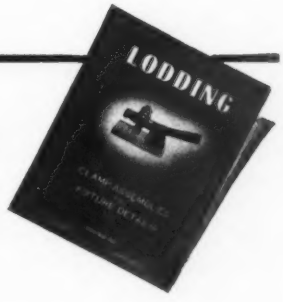

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MOORE SPECIAL TOOL COMPANY

Holes, Contours, Surfaces

Published in the interests of greater accuracy and quality in the toolroom and on the production line by the Moore Special Tool Company, Inc., 726 Union Avenue, Bridgeport 7, Conn., builders of Jig Borers, Jig Grinders, Panto-Crush Wheel Dressers, Die Flippers, Motorized Centers and a complete line of Hole Location Accessories.

ACHIEVING PERMANENCE OF ACCURACY

Just as important as the initial accuracy of a precision machine tool is the *life expectancy* of this accuracy. And the most effective way to insure long-lasting accuracy is to give *dimensional stability* and *wear resistance* special consideration during machine design.

The following causes of dimensional *in*stability are most frequently encountered: thermal expansion, unstable constituents in the material; and stresses in the material. In the design of the No. 2 Moore Jig Grinder, all of these factors were taken into account and special features were incorporated to counteract them.

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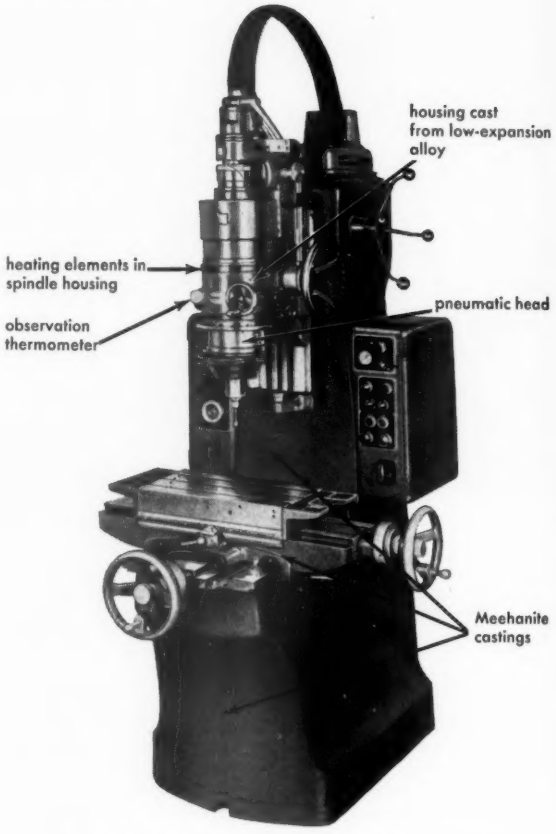

Special design features of the No. 2 Moore Jig Grinder insure permanence of accuracy.

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makes this intricate job possible

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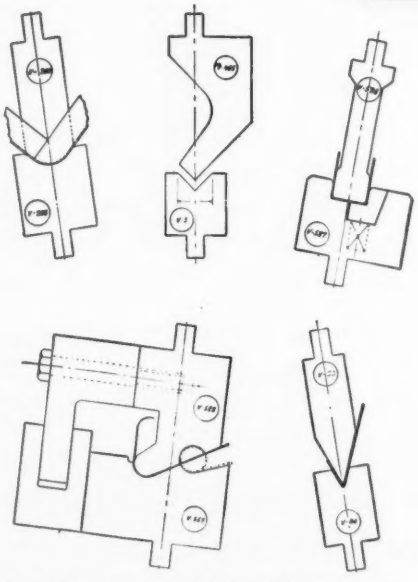

A Verson Press for every job from 60 tons up.

JUST off the press, the new enlarged Silver Anniversary edition of the Verson Die Manual contains 112 pages devoted to a pictorial presentation of Verson press brake dies and special tooling along with detailed text and tables on how to select dies for specific jobs, tonnages required, etc. Representing the culmination of twenty-five years of Verson Die Manuals, this edition has been developed and organized to be as convenient and helpful to the user as we know how to make it, even to the point of incorporating a plastic binding that permits the book to lay flat wherever it is opened. While the Manual does not show every possible press brake die, it is remarkably complete and covers all commonly used types. To get your copy simply write on your company letterhead.

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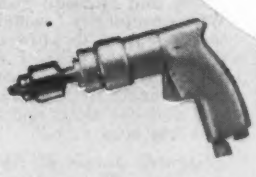

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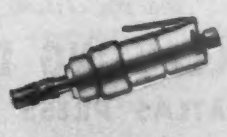

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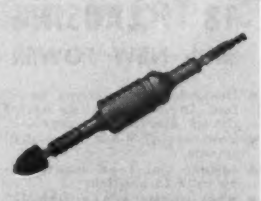

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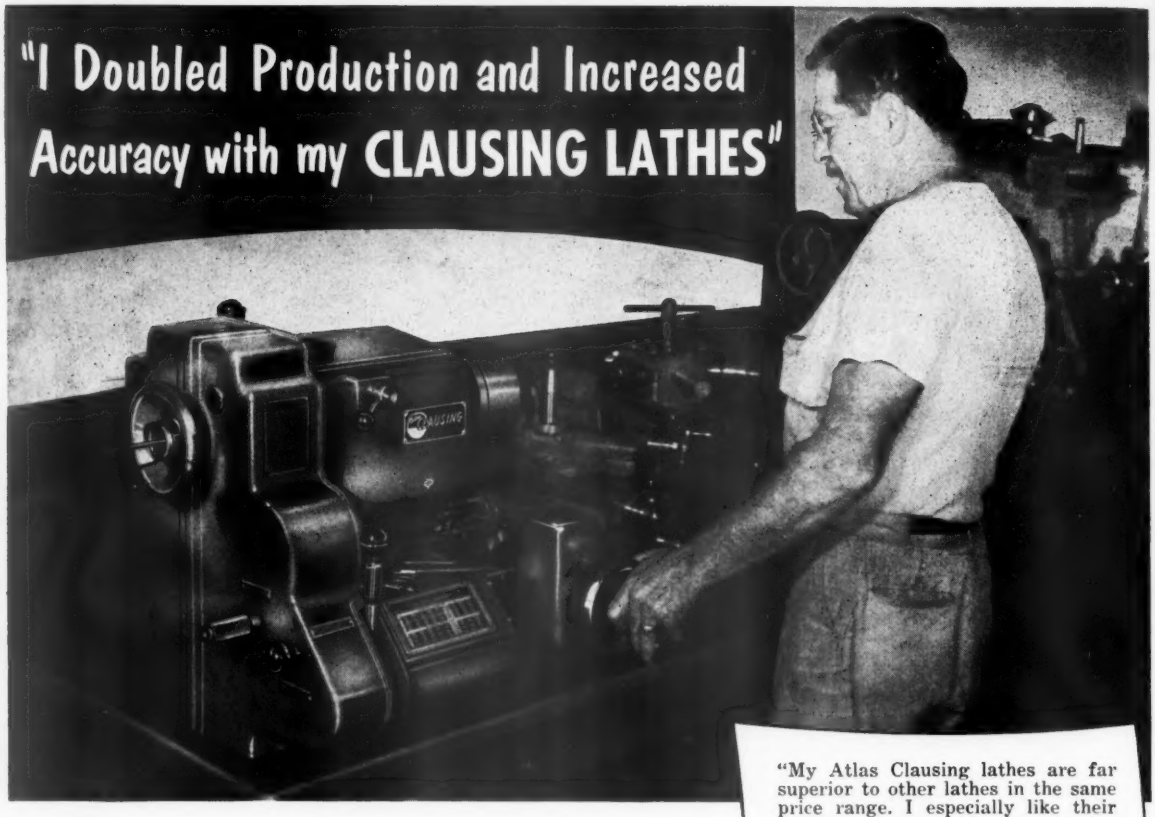

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(signed) James H. Sawyer
Sawyer Metal Products
Miami, Florida

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12" HEAVY DUTY PRECISION LATHE

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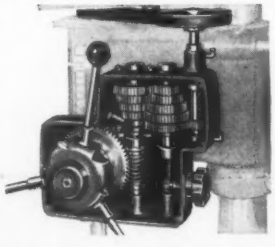
18" CLAUSING DRILL PRESS
with NEW POWER FEED

- Heavy-duty, gear-driven power feed. Drive is thru four sets of change gears, worm gear.
- Powered by V-belt from drill spindle.
- Instant dial feed selection — no belts to position.
- Steel change gears with ½" face. Hardened stress-proof steel worm. Bronze worm gear with ¾" face.
- Worm gear runs in bath of oil.
- Heavy-duty Oilite bearings, with ball thrust bearing on worm shaft.



America's finest low-cost Metal-working Machine Tools

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PRECISION MACHINE TOOLS
DIVISION ATLAS PRESS COMPANY
KALAMAZOO MICHIGAN U.S.A.

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Du Quesne

Duquesne

Dukane

Here in the Pittsburgh district Duquesne is a great name. It identifies and lends distinction to outstanding landmarks and institutions.

Altered—for convenience—to Dukane, it identifies and lends distinction to "Pittsburgh's" outstanding grade of commercial drill rods . . . high carbon fine steel of gem-like precision and flawless finish.

In nearly 200 standard sizes, 2″ to 1/16″ round, Dukane is ideal for an almost limitless range of small cutting and wearing tools and precision parts. Wherever high standards of accuracy, uniformity, straightness and surface finish are indicated, no form of fine steel matches the economy, the adaptability or the serviceability of Dukane drill rods.

Order Dukane by name . . . from "Pittsburgh's" selected distributors coast to coast.

YOURS FOR THE ASKING

1—Descriptive price list.

2—Chart showing standard drill rod sizes, decimal equivalents, weight per foot and weight per 3-foot bar.

3—Catalog No. 6. Compact treatise on all grades of drill rod rounds and shapes, precision ground flats and squares, and other "Pittsburgh" prefinished steels . . . tables, illustrations, heat treating and other information of value to users of fine steels. Ask for it on your letterhead.

PITTSBURGH TOOL STEEL WIRE CO.

Since 1902 . . . makers of drill rods and other cold finished fine steel in all sizes, grades and shapes.

MONACA, PA.

*** FORT DU QUESNE**

Begun in 1754 by a party of Virginians who were soon driven away by the French and Indians . . . completed by the French and named Du Quesne. Burned by the French in 1758. Rebuilt by the English on a larger scale and named Fort Pitt. The blockhouse, then commanding the fort and the three rivers, is now an historical shrine commanding the rivers and the famed Gateway Center-Point Park project at the tip of Pittsburgh's Golden Triangle.

SEE ADVERTISERS INDEX, BACK OF BOOK, FOR INFORM-A-GRAM KEY NUMBERS

Combine WESSON TOOL ENGINEERING SKILL and EXPERIEN

Our 30th Year In Carbide!

This New WESSON Engineere TOOL HOLDER

ROUGH TURNS HOT FORGED 155 MM SHELLS

The rugged strength and durability of the Wesson Holder is obvious in above picture. Chip wear is on the replaceable band.

STYLES PAR-B and PAL-B

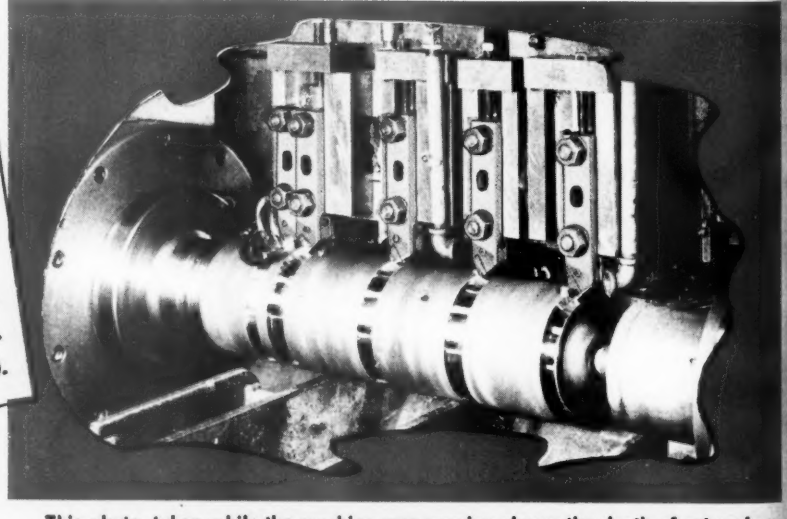
WESSON MULTICUT PARALLELOGRA BAND TYPE HOLDER

WESSON BAND TYPE HOLDERS ARE VIRTUALLY INDESTRUCTIBLE EVEN UNDER ABNORMAL CONDITIONS. THE STEEL BAND IS REPLACEABLE AT VERY LOW COST. 101 DIFFERENT STANDARD STYLES AND SIZES ARE AVAILABLE.

ACTUAL JOB SETUP NOW AT A LARGE SHELL MANUFACTURING CO.

Part.....155 MM hot forged shell.
Operation.....Rough turning.
Machine..Burleigh Stocker Hydra-Feed automatic lathe.
Tools.....5 Wesson Multicut Band Type Parallelogram Tool Holders with Parallelogram Wesson-metal insert grade WM.
Depth of cut.....Up to 1" maximum.
Feed.....032 per revolution.
S.F.M.....320.

The Wesson Tool Engineer in your area has full details on this job. Ask him about Case History #135.



This photo, taken while the machine was running shows the depth of cut and type of finish obtained by rough turning with Wesson Holders and Wesson-metal insert. Note extra holder strength possible with the parallelogram insert. The lead angle is 25°.

WESSON COMPANY

1220 WOODWARD HEIGHTS BLVD. FERNDALE (DETROIT 20), MICH.

WESSONMETAL HIGH PERFORMANCE *for Increased Production . . .*

And *This*

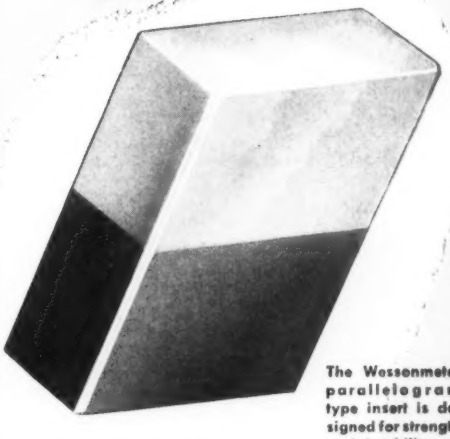
WESSONMETAL INSERT

WITH CUTS UP TO 1" DEEP!

Another FIRST for WESSON

with Tool Costs Reduced by Over 60%
Production Increased 400%

OLD METHOD	NEW WESSON METHOD
Tool Cost.....$37.50	Tool Cost.....$50.00
Useable Carbide.....3/8"	Useable Carbide.....9/16"
Average Pieces per Grind...60	Average Pieces per Grind...60
Pieces Machined per Tool..420	Pieces Machined per Tool..1680
Tool Cost per Piece.....8.1c	Tool Cost per Piece.....2.9c
Down Time for Tool Change... 15 min. every hour	Down Time for Tool Change... 4 min. every hour



The Wessenmetal parallelogram type insert is designed for strength and durability.

½" x 1" x 1½" either solid or with brazed steel slug on bottom for back up screw contact.

WESSONMETAL IS OUTSTANDING FOR HIGH PERFORMANCE BECAUSE IT IS UNIFORMLY DEPENDABLE IN QUALITY

WESSONMETAL *is available in 8 grades for all types of metal working.*

SEE THE DRAMATIC STORY OF CARBIDE in Sound and Color "THIS CARBIDE AGE" There's a Wesson Tool Engineer in your area who will give you full details about this fine educational movie. Call him or write.

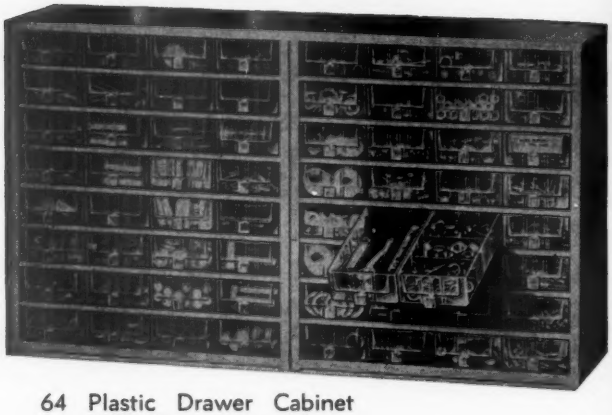
WESSON METAL CORPORATION

LEXINGTON 34, KENTUCKY

NOW

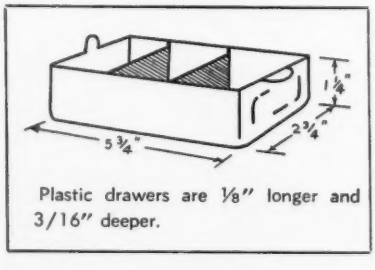
JIFFY CABINETS WITH METAL OR PLASTIC DRAWERS

- **7 useful cabinet sizes**
- **Aluminum or see-thru plastic drawers**
- **Individual drawer guides**
- **Removable drawer-dividers**
- **Safety catch on back of each drawer to prevent accidental spilling of contents**



64 Plastic Drawer Cabinet
(192 Compartments)

Index label and 2 removable drawer dividers for each drawer.



Plastic drawers are 1/8" longer and 3/16" deeper.

HANDIEST CABINET EVER BUILT FOR STORING SMALL ITEMS

No more frantic searching for misplaced items at home, shop, office or factory! EVERYBODY needs this convenient storage cabinet where small parts and supplies can be kept indexed, orderly, clean and easy-to-find. Your Jiffy Cabinet holds bolts, nuts, nails, screws, washers, drills, tools, repair parts, carbide tips, labels, radio parts, film . . . plus hundreds of other small, easily misplaced items! Attractive baked-on, silver-gray hammer-finish steel frame with rubber feet that won't mar any surface.

CLIP AND MAIL TO: HANDY PRODUCTS, P. O. BOX 2447, CLEVELAND 12, OHIO

PLEASE SEND IMMEDIATELY THE QUANTITY AND SIZE JIFFY UNIT LISTED BELOW

PLASTIC Drawer Cabinets ☐ 64 Drw. @$24.95* ☐ 48 Drw. @$20.95* ☐ 32 Drw. @$12.95* ☐ 24 Drw. @$9.95* ☐ 16 Drw. @$6.95* ☐ 12 Drw. @$5.95* ☐ 8 Drw. @$4.25*

METAL Drawer Cabinets ☐ 64 Drw. @$24.95* ☐ 48 Drw. @$19.95* ☐ 32 Drw. @$12.95* ☐ 24 Drw. @$9.95* ☐ 16 Drw. @$7.95* ☐ 12 Drw. @6.95* ☐ 8 Drw. @$4.95*

WE PAY ALL SHIPPING COSTS

NAME .....
STREET .....
CITY ..... ZONE ..... STATE .....
ORDERED BY ..... DEPT. .....

☐ Open Account, Purchase Order Enclosed.
☐ Check or Money Order Enclosed.
No. C.O.D.'s, Please.
*Ohio Customers Add 3% Sales Tax.

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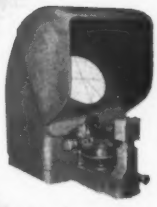
11 MODELS

3 SCREEN SIZES

Pedestal Type
14" Diam. Screen



Bench Type
14" Diam. Screen
4 Models

Bench Type
5¾" x 7⅞" Screen
3 Models

Unsurpassed Inspection Versatility

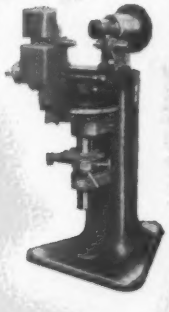
JONES & LAMSON OPTICAL COMPARATORS

The Essence of Quality Control

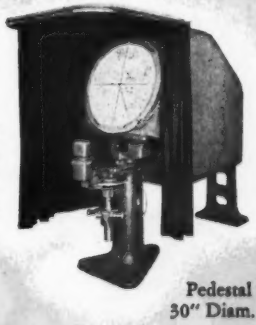
Jones & Lamson Optical Comparators are designed and built like rugged machine tools to withstand vibration and hard use. Yet they have the built-in accuracy to satisfy the most exacting laboratory standards.

- **They meet** the requirements of toolroom, laboratory and production inspection.
- **They precisely measure** height, depth, lead or spacing, as well as angles to degrees and minutes. They will measure to .0001".
- **They compare** intricately contoured parts with a master outline—and measure the amount of error.
- **They are convenient** to operate, easy to set up and read direct—*without computation.*
- **They operate** under normal lighting conditions. *No darkroom is needed.*
- **They will photograph** the enlarged shadow and record its relationship to a master chart.
- **Several persons** may study the shadow *at the same time.*
- **They will inspect** and measure surface contours, as well as profiles of objects such as type faces, stamping dies, punches, worn tools, etc.

Vertical Type
14" Diam. Screen



Direct
Projection
Type



Pedestal Type
30" Diam. Screen

P.S. A complete line of STANDARD CHARTS and FIXTURES is maintained by us.

JONES & LAMSON

JONES & LAMSON MACHINE COMPANY
519 Clinton St., Springfield, Vt., U.S.A.

Machine Tool Craftsmen Since 1835

COMPARATOR DIV.
Dept. 710

Jones & Lamson Machine Company
519 Clinton Street, Dept. 710
Springfield, Vermont, U. S. A.
Please send Comparator Catalog No. 402.

NAME_____ TITLE_____

COMPANY_____

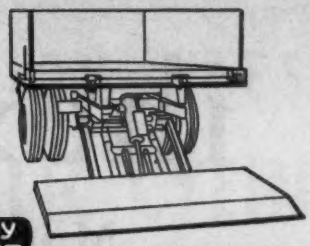
STREET_____

CITY_____ STATE_____

SEE ADVERTISERS INDEX, BACK OF BOOK, FOR INFORM-A-GRAM KEY NUMBERS

Various Sizes and Graduations
Shockproof
Dial Indicators
Converts AGD Adjustable Limit Snap Gages to Dial Type Instruments
Patented
Dializers
Adjustable Limit Snap Gages
Dial Bore Gages
8 Sizes Cover Range ¼"-12⅛"
Just a few of many
STANDARD Gages
In so many ways they help you do the job better . . . easier!
Dial Comparators
Dial Snap Gages
DuBo Plug Gages
Patented
Light in Weight Sensitive, Definite Check
Master Setting Gages
Write for the New Catalog C
STANDARD Gages
STANDARD GAGE COMPANY, INC.
CATALOG C
STANDARD GAGE CO., INC., Poughkeepsie, N.Y.

Checking the dies in a DANLY SPECIAL DIE SET—all steel, 4-post type, 26" x 35".



ANTHONY LIFT GATE HYDRAULIC

SHOWN IN LOADING POSITION

DANLY SPECIAL DIE SETS

View showing DANLY SPECIAL DIE SET during production run. Tail gate gussets are blanked and pierced in a single stage operation from 10 gage blue annealed sheet.

DANLY®

DIE SETS . . . STANDARD OR SPECIAL
DIEMAKERS SUPPLIES

help Anthony give industry a lift!

For years now, the Anthony Company, makers of hydraulic lift gates for motor trucks, has relied on Danly Special Die Sets in their production operation. Based on long experience, they've found that Danly Special Die Sets cut their tooling costs and save time . . . because they provide the finest precision starting point for diemaking. Why not build your production dies in Danly Special Die Sets? . . . see what die performance can really mean.

DANLY MACHINE SPECIALTIES, INC.
2100 South Laramie Avenue, Chicago 50, Illinois

DANLY SPECIAL DIE SET SERVICE IS FAST AND CONVENIENT—CALL YOUR NEAREST DANLY BRANCH

***CHICAGO** 50	2100 South Laramie Avenue
***CLEVELAND** 14	1550 East 33rd Street
***DAYTON** 7	3196 Delphos Avenue
***DETROIT** 16	1549 Temple Avenue
***GRAND RAPIDS**	113 Michigan Street N.W.
INDIANAPOLIS 4	5 West 10th Street
***LONG ISLAND CITY** 1	47-28 37th Street
***LOS ANGELES** 54	Ducommun Metals & Supply Co., 4890 South Alameda
MILWAUKEE 2	111 East Wisconsin Avenue
***PHILADELPHIA** 40	511 W. Courtland Street
***ROCHESTER** 6	33 Rutter Street

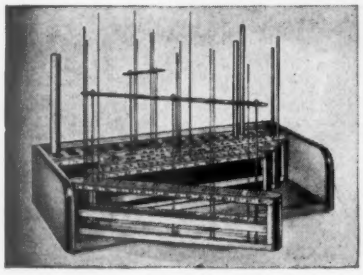
*Indicates complete stock

inexpensive

. . . Money Saving Accessories For Your Plant

Each of the accessories illustrated and described below was designed and built for a definite need and used in our own plant before being offered to industry. They require a relatively small investment, yet will save you money every day. For further information, write for the folder offered below.

DRILL ROD RACK

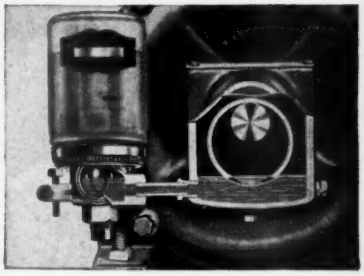


Eliminate trouble and waste effort with this modern method of storing drill rod. Put the Acro rack in a central location of each department and make it simple for each mechanic to select correct rod size in a hurry. It also provides a visual inventory for checking rod replacements.
Accommodates 26 letter sizes, 52 pieces; 47 fractional sizes, 138 pieces; 60 number sizes, 304 pieces. Fractional sizes graduated in 64ths from 1/32" to ½" and in 32nds from ½" to 1" included.

LEADER PIN OILERS

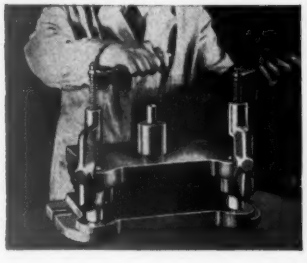
Eliminate wear on your die sets with these leader pin oilers. Acro Pin Oilers, as illustrated, fit over each leader pin and seals in place with a rubber neoprene washer. Each cup is filled with oil so each downward stroke brings bushing in contact with oil and each upward stroke distributes oil evenly over leader pins. Eliminate bushing wear, leader pin scoring, and maintains die accuracy. Die sets equipped with Acro Pin Oilers have run under tests for several weeks to a month without refilling.

AUTOMATIC LUBRICATORS



With this Acro lubricator, you can lubricate oil ring, capillary, ball or roller bearings on electric motors, blowers, lineshafts and similar bearings for periods as long as six months to one year with one filling. You can save 50 to 95 per cent in oil consumption, practically eliminate maintenance labor and burned out bearings due to faulty hand oiling and guesswork. In addition to savings effected in labor and maintenance, Acro lubricators soon pay for themselves in oil savings alone.

DIE SET PULLERS



The principle of the Acro Die Set Puller is to remove the punch holder from the die shoe by a straight upward pull, whereby punch holder travels upward from die shoe axially, leaving both leader pins simultaneously. This is accomplished only by use of the indexed screw wrenches which act as indicators, controlling the upward travel. This is an exclusive patented Acro feature, found only in Acro Die Set Pullers.

Free Data

covering each of these profitable accessories is included in our folder. Write for bulletin TP-52.

ACRO

METAL STAMPING CO.

330 EAST RESERVOIR AVE.

MILWAUKEE 12, WIS.

FOR PRODUCT INFORMATION USE CONVENIENT INFORM-A-GRAM CARD

Miller HIGH PRESSURE HYDRAULIC CYLINDERS

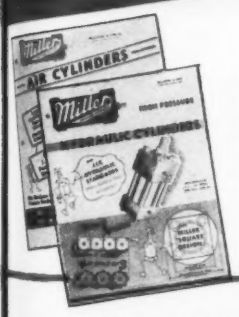
HARD CHROME PLATED PISTON RODS
Prevent Scratch-Damage, Nicks and Rust

SOLID STEEL HEADS, CAPS and MOUNTINGS
Eliminate Breakage

Visit Our
BOOTH #1217
at the October
"METALS" SHOW
. . . and see our
"College of Cylinder Knowledge"

DIRT WIPER SEALS
Protect Rods, Seals, Bushings

Standard Leather Cup Seal Assembly Shown Is Interchangeable With Miller Standard Piston Ring Piston Assembly



WRITE FOR CYLINDER BULLETINS H-104 and A-105

Complete Miller cylinder line includes: air cylinders, 1½" to 20" bores, 200 PSI operation; low pressure hydraulic cylinders, 1½" to 6" bores for 500 PSI operation, 8" to 14" bores for 250 PSI; high pressure hydraulic cylinders, 1½" to 12" bores, 2000-3000 PSI operation. All mounting styles available.

MET J. I. C. HYDRAULIC STANDARDS years before their adoption in 1949.

SPACE-SAVING SQUARE DESIGN originated by Miller in 1945.

SALES AND SERVICE FROM COAST TO COAST

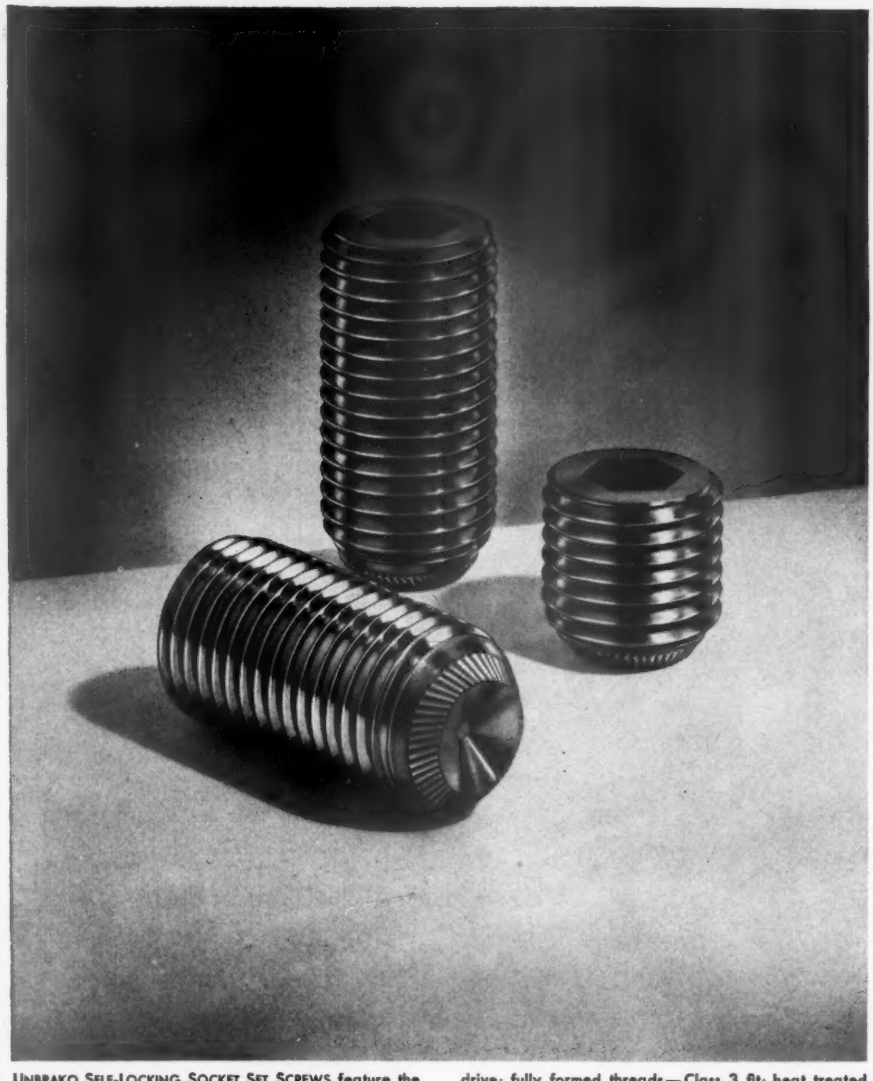
CLEVELAND • YOUNGSTOWN • DAYTON • PITTSBURGH • PHILADELPHIA • BOSTON • HARTFORD • NEW YORK CITY • BUFFALO • ST. PAUL • GRAND RAPIDS • DETROIT • FLINT • FORT WAYNE • SOUTH BEND • INDIANAPOLIS • MILWAUKEE • LOUISVILLE • KANSAS CITY • SEATTLE • LOS ANGELES • SAN FRANCISCO • BALTIMORE • DENVER • ST. LOUIS • MOLINE • CHICAGO • HOUSTON • TORONTO, CANADA and OTHER AREAS

Miller

MILLER MOTOR COMPAN

2046 N. HAWTHORNE AVE., MELROSE PARK, ILL.

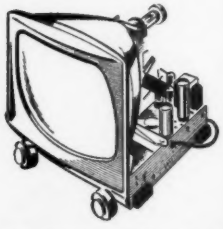
AIR & HYDRAULIC CYLINDERS • BOOSTERS • ACCUMULAT
COUNTERBALANCE CYLINDERS



UNBRAKO SELF-LOCKING SOCKET SET SCREWS feature the following advantages: knurled cup point that won't work loose; accurate hex socket for nonslip, positive drive; fully formed threads—Class 3 fit; heat treated alloy steel for strength; standard sizes—#4 to 1"—in a full range of lengths.

Our Fiftieth Year

A START FOR THE FUTURE



USE UNBRAKO SELF-LOCKING SOCKET SET SCREWS wherever ordinary cup point set screws are used . . . on radios, television sets, electronic equipment.

On refrigerators, washing machines, and other household appliances.

On power mowers, power saws and other power tools.

9 times out of 10 a standard UNBRAKO will do the job

A special socket screw may not be necessary, a standard UNBRAKO usually does the same job—much cheaper. Your local industrial distributor stocks Standards. He gives immediate attention to your requirements, and such extras as special delivery to your plant. Write for UNBRAKO Standards. SPS, Jenkintown 36, Pa.

Write for UNBRAKO Standards

UNBRAKO® SOCKET SCREW DIVISION

SPS JENKINTOWN PENNSYLVANIA

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MAMMOTH

or MINIATURE....

The LONG and SHORT of Measuring Versatility

From four inches to fifteen feet, there's an ETALON Instrument to meet your needs!

Manufactured of *specially selected* STAINLESS STEELS — HARDENED and NORMALIZED — ETALON CALIPERS are helping to maintain standards of accuracy in shops the world-over.

Whenever you require *accurate and dependable* calipers, micrometers, height gauges, indicators or other precision measuring instruments — follow America's leading manufacturing plants — *SPECIFY ETALON TO BE SURE OF THE FINEST!*

ETALON
PROCH. ROLLE. "SWITZERLAND"
ACCURACY

Ask your dealer or write us!

ALINA CORPORATION
401 BROADWAY, NEW YORK 13, N. Y.

SEE ADVERTISERS INDEX, BACK OF BOOK, FOR INFORM-A-GRAM KEY NUMBERS

WHAT'S THIS?

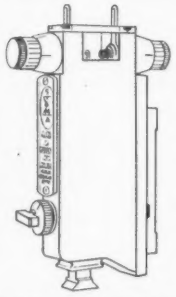
HIGH SPEED 100% INSPECTION

SIGMA

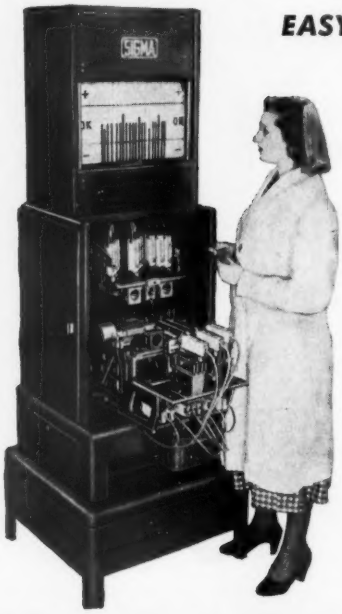
One machine is accurately checking 8 dimensions simultaneously—separating correct, oversize, and undersize parts at a rate of 2100 an hour.

Two girls now handle an inspection job that formerly took six—and human errors have been eliminated.

Eight, standard Sigma gauges, like this one: have been mounted together for rapid, accurate inspection of mass produced parts. Each gauge, accurate to within .00005", measures one dimension. More (up to 30) or fewer gauges could have been used, depending on the number of dimensions to be checked. These gauges, with standard Sigma mounting units, and special fixtures where necessary, can be set up to inspect parts a fraction of an inch long, or several inches long, a foot, or longer.

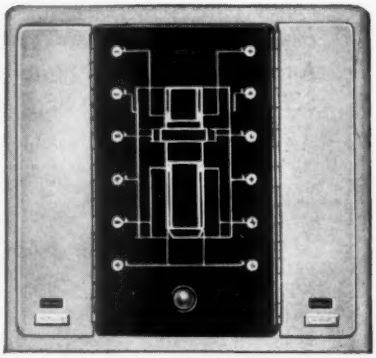


Depending on the arrangement, they can check internal and external diameters, length, depth, or other characteristics. The type of parts and the method of feeding determine inspection rates—hand feed: up to 600/hr.; semi-automatic: up to 900/hr.; fully automatic: up to 3500/hr. or more. Gauges are quickly and easily set to required tolerances and change-over from inspecting one type of part to another can be done within 10 or 20 minutes.



EASY-TO-READ INDICATORS WITH SIGMA EQUIPMENT

The semi-automatic Turbine and Compressor Blade Inspector (left) is an excellent example of Sigma's solution for a difficult inspection problem involving 18 dimensions. Fixtures are replaceable—each machine can inspect a wide range of different type parts. Gauges are connected to a Liquicolumn Indicator which has tubes of colored liquid set beside graduated scales—liquid levels indicate actual sizes of dimensions being checked. Magnifications can be varied easily by the user. Alternate indicator (right) uses electrical signals—green light for acceptable parts, red lights indicate dimensions below tolerances, yellow lights for those over. Built-in counters tabulate the number of parts submitted for inspection and the number accepted.



Contact us and get details on the Sigma equipment best suited to your high speed, multi-dimensional inspection problems.

COSA CORPORATION

405 Lexington Ave., New York 17

Your source for all Precision Machine Tools—from Small Bench Lathes to Large Boring Mills

IN DETROIT AREA contact DETROIT-COSA CORPORATION, 16923 James Couzens Highway, Detroit 35, Mich.

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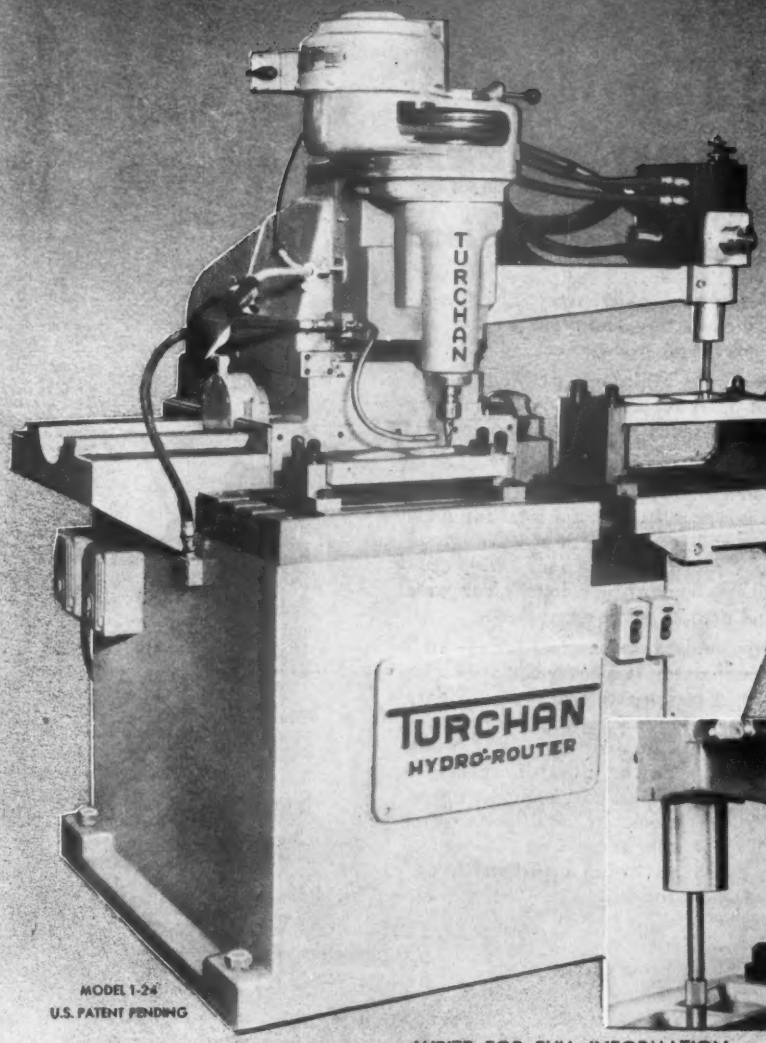
NEW—3-DIMENSIONAL!

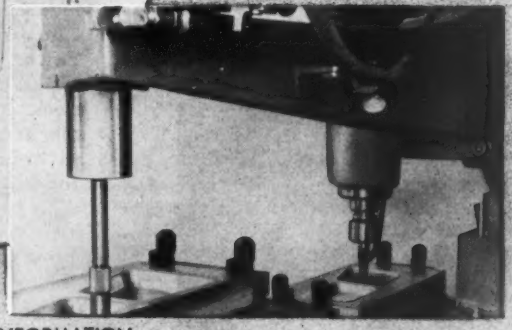
Turchan HYDRO-ROUTER

• SERVO-CONTROLLED
• FAST, ACCURATE
• SIMPLIFIES COMPLEX MILLING and ROUTING



Greater sensitivity, accuracy and increased duplicating speed result in hours of costly time saved on dies, forms and moulds with Turchan's new Hydro-Router. Controls are grouped in easy reach of operator; virtually eliminating fatigue. Infinitely variable automatic tracer-controls produce a superior finish. Turchan Hydro-Routers available in many sizes; each with a wide range of speeds and feeds.

Turchan has what industry needs in the trend to Automation



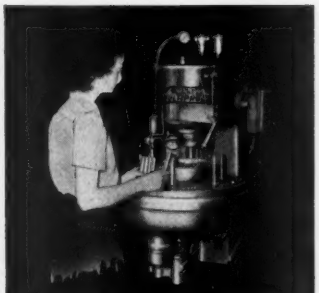
MODEL 1-24
U.S. PATENT PENDING

WRITE FOR FULL INFORMATION

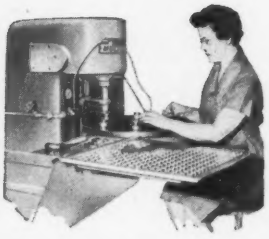
Turchan FOLLOWER MACHINE CO.

Machine Tools Division, 8259 Livernois Avenue, Detroit 4, Michigan

For 20 years, designers and builders of automatic hydraulic tracer-controlled equipment for standard machine tools and special machines



Assembly speed is doubled using Multipress to crimp a small brass contact to pen-type flashlight cases.



Scrap losses drop sharply as Multipress doubles staking speed on high precision voting-machine counter wheel assembly.

Output is boosted 100% by famous toy train maker, staking a 6-part assembly together with Multipress.

MULTIPRESS® DOUBLES PRODUCTION SPEED

On Six More Typical Operations

Faster production, better quality, less scrap, safer operation, easier handling, quieter action, and other profit-boosting results are run-of-mine with Multipress.

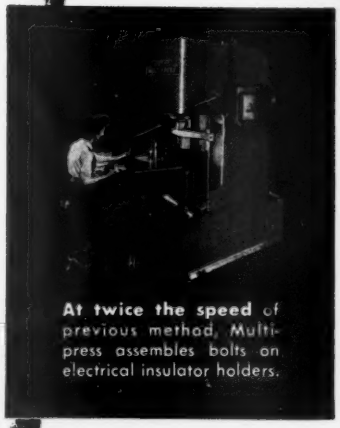
In the six cases shown here, Multipress *doubled* production rates. Hundreds of other reports tell of gains ranging up to 8 and 10 times the speed of previous equipment.

How does Multipress do it *so consistently?*

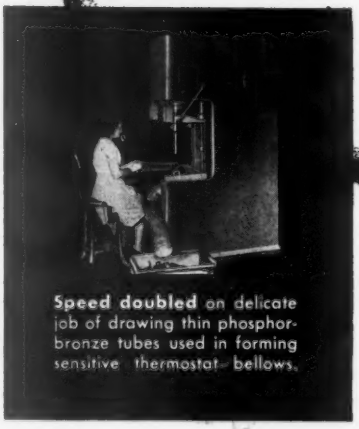
It is uniquely engineered to provide the smooth, controlled action of oil-hydraulic power *at its versatile best!* Infinitely adjustable ram pressures and stroke length make it easy to eliminate all unnecessary ram *travel* and ram *effort. Controlled* ram speed eliminates hammer-blow impact, cuts wear and tear on tooling, and permits better metal flow.

Multipress also offers standard attachments for extra efficiency on most production needs. It is easily equipped with automatic feeds, indexing tables, ejection devices, auxiliary ram actions . . . controls for automatic time-delay, hold-down, vibratory pressure application, sequence operations, etc. Multipress offers nine frame sizes . . . one-ton to 75-ton capacities. Write for details!

In only four stages, Multipress deep-draws a precision ordnance part formerly requiring 8 draws.



At twice the speed of previous method, Multipress assembles bolts on electrical insulator holders.



Speed doubled on delicate job of drawing thin phosphor-bronze tubes used in forming sensitive thermostat bellows.

DENISON HydrOILics

The DENISON Engineering Co.

1197 Dublin Road, Columbus 16, Ohio

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we are expanding our facilities to bring you...

more "Desegatized."® steel—faster!

In order to improve our service to tool steel users, we have expanded our warehousing facilities since October, 1950, by erecting a new warehouse at Los Angeles to serve the West Coast . . . moving from downtown Chicago to a new, larger warehouse in suburban Melrose Park, Illinois . . . replacing our Detroit warehouse with improved location and facilities at Centerline, Michigan . . . adding to warehouse at Hartford to nearly double its capacity . . . enlarging warehouse and shipping facilities at Latrobe.

and now—we are moving our New York district sales office to a new office and warehouse at Hillside, New Jersey. Just south of Newark, this location is ideally suited to serve our many customers in northern New Jersey, greater New York and the Hudson River valley.

A growing fleet of Company-operated trucks brings plants east of the Mississippi River within a one or two day delivery cycle from our warehouses or our manufacturing facilities at Latrobe, Pennsylvania.

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LATROBE, PENNSYLVANIA

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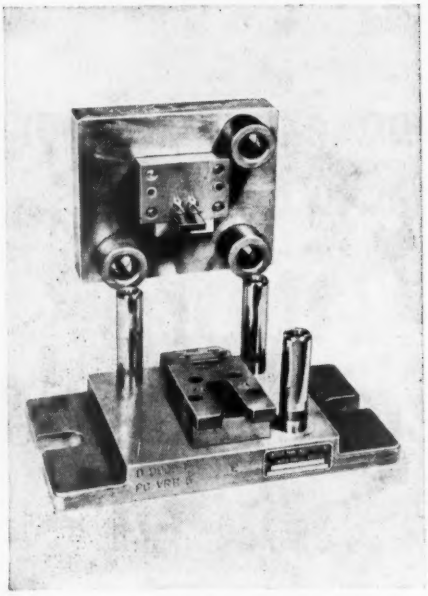
EUROPEAN OFFICES IN

GENEVA PARIS BRUSSELS ROTTERDAM MILAN

Whether your dies are simple...

you can speed production, save time and money,



1 Simple pierce and cutoff die, designed for Electric Auto-Lite Co., Toledo, operates at speeds faster than 400 strokes per minute. Die has produced over 2,000,000 strokes . . . and still does not require resharpening.

Actual performance records prove carbide dies effective over wide range of uses

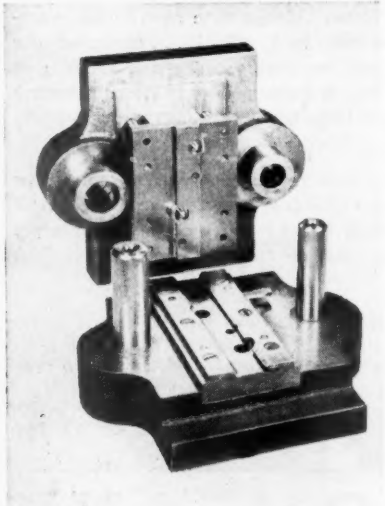
ACTUAL plant performance has proved how easy and profitable it is to use Carboloy cemented carbide over a wide range of applications. For blanking, forming, drawing and piercing . . . for large or small, simple or complex dies . . . only carbides will give you benefits like these:

- **Production runs 35 times greater than steel (see picture No. 7)**
- **Over two million high-speed strokes . . . without needing resharpening (see picture No. 1)**
- **Accurate tolerances held for months . . . compared to days with steel (see picture No. 6)**

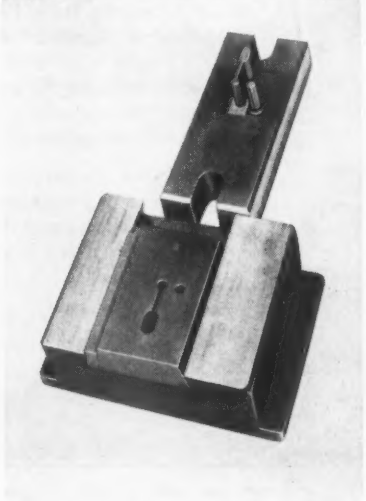
Read the case histories on these pages. They are but a few from the wide range of carbide press-die applications. Then explore the possibilities of carbide in your press dies. Carboloy personnel and services will give you or your die maker every possible assistance.

If you wish, a Carboloy Sales Engineer will call at your plant, without obligation. He'll show you how simple it is to apply and maintain carbide dies; how to get increased production with fewer rejects. Or, you can send your key personnel to the Carboloy Training School in Detroit.

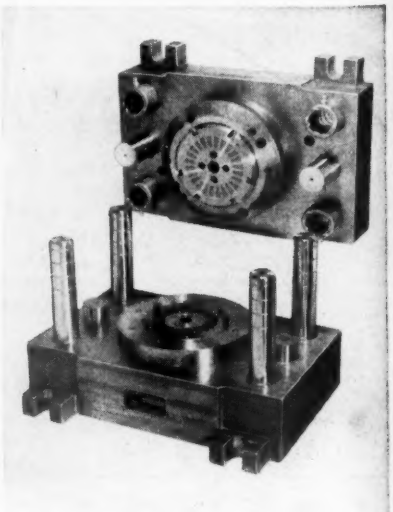
Also, you can get free Carboloy Die Engineering Manual D-124. It shows you how easy it is to design, apply and maintain carbide dies. Get all these free, profit-building Carboloy services by mailing the coupon at right.



2 Simple progressive washer die, used at Precision Spring Company, Detroit, Michigan, pierces and blanks spring-tempered steel washers. This die delivers several million hits per sharpening.



3 Notching die, wearproofed with Carboloy cemented carbide, stands up under severe day-after-day pounding. Because carbide wears 10 to 50 times longer than steel, maintenance costs are lower.



4 Piercing die, made for E.M.F. Dordt, Holland, was designed to pierce a small stator in 24 places. When dies have been wearproofed with cemented carbide, production increases, downtime decreases.

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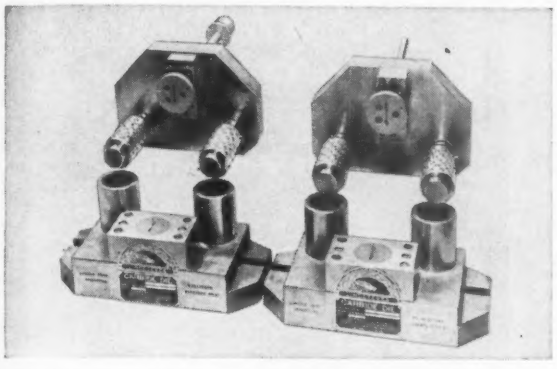
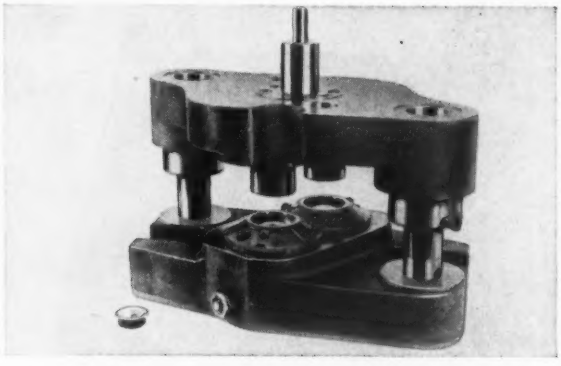
or whether they are complex

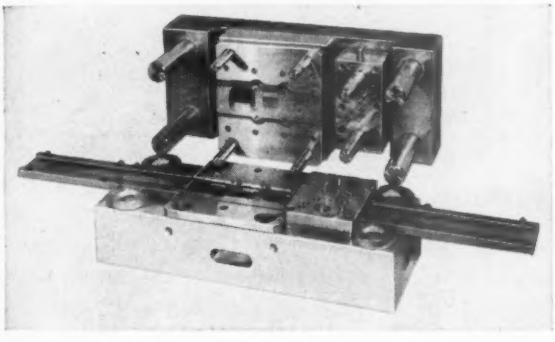
by equipping them with CARBOLOY®
CEMENTED CARBIDE



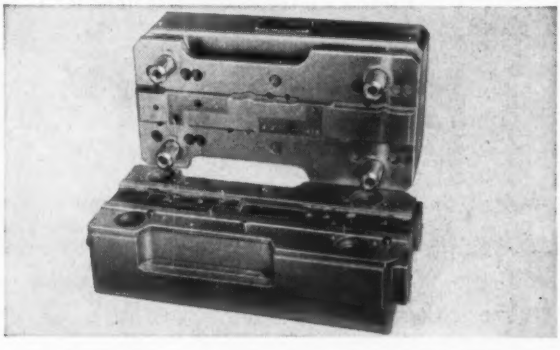
5 Single notching dies, also made for E.M.F. Dordt, Holland. Special design permits details to be interchanged on the same shoes to take full advantage of the carbide in short-run production.



6 Blanking and drawing of screw bottle caps is done by this die for Armstrong Cork Company, Lancaster, Pa. Die operated accurately on material .006" thick for months. Steel die had to be changed each week.



7 Lamination die made for Schick, Inc., produces rotor and stator laminations of motor-grade silicon steel. Customer reports carbide die produces average runs 35 times as long as steel dies.



8 Lamination die punches two, high-silicon "L" laminations per stroke. Dies of this type are in use throughout the metal-working industry, outwearing and outproducing steel dies time and again.

CARBOLOY
DEPARTMENT OF GENERAL ELECTRIC COMPANY

"Carboloy" is the trademark for the products of the Carboloy Department of General Electric Company

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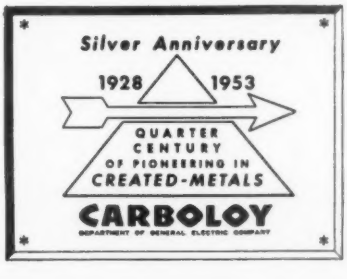

CARBOLOY Department of General Electric Company
11111 E. 8 Mile Ave., Detroit 32, Michigan

- ☐ Rush me free Carboloy Die Engineering Manual D-124
- ☐ Send complete details on free Carboloy Training School
- ☐ Have a Carboloy Field Engineer call at my plant

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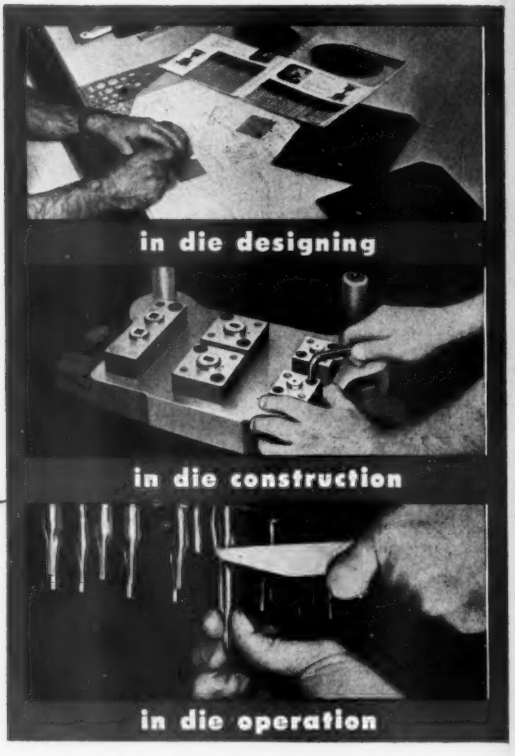
WHERE R-B Punches cut your costs



IN DIE DESIGNING

. . . you save "board time" by working with the standardized R-B concept of punches, die buttons, punch retainers and die button retainers. R-B standardized equipment reduces drafting time to cut your costs.

IN DIE CONSTRUCTION

. . . you save "building time" because R-B punches, die buttons, punch retainers and die button retainers are furnished completely finished. R-B saves skilled die-maker's time to cut your costs.

IN DIE OPERATION

...you save "press time" because R-B punches and die buttons are instantly removed and replacements quickly inserted. Inherent accurate alignment and positive locking keep press down-time at a minimum to cut your costs.

Use R-B Engineering Service for Your Tough Piercing Problems.

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ALLIED PRODUCTS CORPORATION
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SPECIAL COLD FORGED PARTS
STANDARD CAP SCREWS
PRECISION GROUND PARTS
SHEET METAL DIES MADE OF FERROUS ALLOYS, ZINC ALLOYS OR PLASTICS

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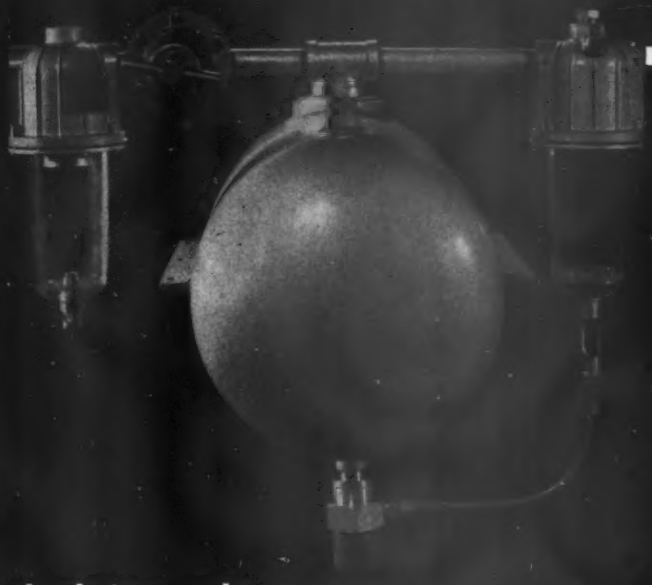
IT'S NEW... lo-jet acro*



the revolutionary new coolant system that . . .

keeps cutting tool and work at room temperatures!

lo-jet acro's *proven results in America's leading industries are making production history, from coast to coast!*

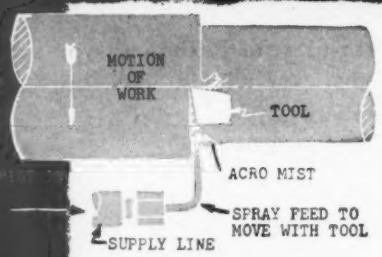
* Controlled compressed air operation for all types of metal cutting with special ACRO-COOLANT soluble solution.

Pictured here is the 8 1/8" outlet centrifugal equalizer distributor with 8 copper tube spray feed. This assembly serves 8 cutting operations.

lo-jet acro

- prolongs tool life
- cuts tool breakage loss
- saves money
- speeds production
- keeps work clean

there is a lo-jet acro *system for every purpose and every machine.*



write now for more information at no obligation.

Our engineering staff will cooperate free of charge.

lo-jet acro *is a product of*

AIR CONVERSION RESEARCH
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Air Conversion Research Corp.
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Gentlemen: Please send me full information about lo-jet acro's coolant system.

name and title_____
firm_____
address_____
city and zone_____ state_____

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MR. DUPLICATOR

AN OPEN LETTER TO SUPERINTENDENTS

Mr. Duplicator Says — *Walker, you as originator of the hydraulic duplicating attachment for machine tools should write an open letter to all superintendents to let them know about tracer controlled machining.*

TO ALL SUPERINTENDENTS:

Our hydraulic duplicators have been proven over a period of more than 20 years and this type of equipment is here to stay. Walker Hydraulic Duplicators have been and can be placed on any machine tool that needs to turn, mill, plane or grind . . . with steps, tapers, radii or straight turn . . . either boring, facing, or contour milling.

If you are not familiar with tracer controlled machining you can discover it for your company. Many have found tracer controlled machining to be the most gratifying and greatest time saver ever encountered.

One well known shop is turning form dies in 1½ hours that previously took 12 hours. A boring mill job was cut from 60 hours to 15 hours with a Walker Hydraulic Duplicator. Many other jobs are being done with comparable savings when traced controlled machining is applied.

Send us a sketch or print of the part you wish to machine and size and make of machine tool that you wish to modernize and we will send you a firm, understandable quotation.

C. E. Walker, President
Walker Hydraulic Duplicator Co.

REPRESENTATIVES IN PRINCIPAL AREAS

Walker HYDRAULIC DUPLICATOR CO.
P. O. Box 460 STANDISH, MICHIGAN
Pioneer Designers and Builders of Precision Duplicating Equipment

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Accurate Die Alignment Reduced Die Maintenance

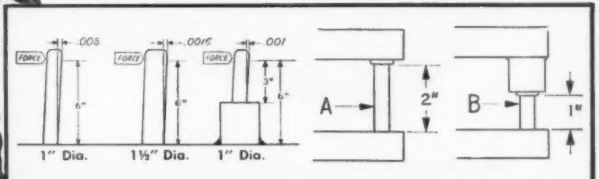
with SUPERIOR

N-K*

DIE SETS

OVERCOME FORCES THAT CAUSE A DIE TO SHEAR ITSELF, CHIP ITS CUTTING EDGES, BREAK PUNCHES, PRODUCE IRREGULAR BREAK LINES, AND CAUSE LARGE AND IRREGULAR BURRS ON THE PARTS PRODUCED.

Superior N-K Die Sets incorporate welded bosses around pins or bushings to increase the accuracy and durability of the die set. These welded bosses shorten the unsupported pin length which in turn greatly reduces pin deflection. Misalignment caused by press irregularities, irregular forces and thrusts within the die itself are minimized, because N-K Die sets bring the pivot point down to or below the cutting plane.



With the same amount of side thrust A is deflected *8 times more* than B. The above illustrations show how welded bosses on Superior N-K Die Sets greatly decrease the amount of pin deflection.

Write, phone or wire today for complete FREE information, on Superior N-K Die Sets.

5 TON SUPERIOR N-K DIE SET

FOR FAST LOCAL SERVICE CALL THESE SUPERIOR REPRESENTATIVES

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2754 S. 19th ST., MILWAUKEE, WIS.

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You Can Depend on

JOHANSSON GAGING EQUIPMENT

It Assures You Precision to the Finest Degree, — to Meet Your Most Exacting Requirements — Backed by the Name Supreme in the World of Measurement.

- **GAGE BLOCKS (JOHANSSON) and accessories.** Short deliveries. Inspection and reconditioning service available at our plant
- **INTERNAL INDICATORS** (or inside measurements. 155 to 24 inches) Scale range plus or minus .001 graduated to .0001 and minus .020 graduated to .0001.
- **MIKROKATOR** (Amplifier — for outside measurements) Graduations .0001 to .000002 or .001 M to .0002 M
- **OTHER JOHANSSON PRODUCTS** Micrometers, Snap gages, Extensometers, Dynamometers, Hardness Testers, Surface Finish Indicators

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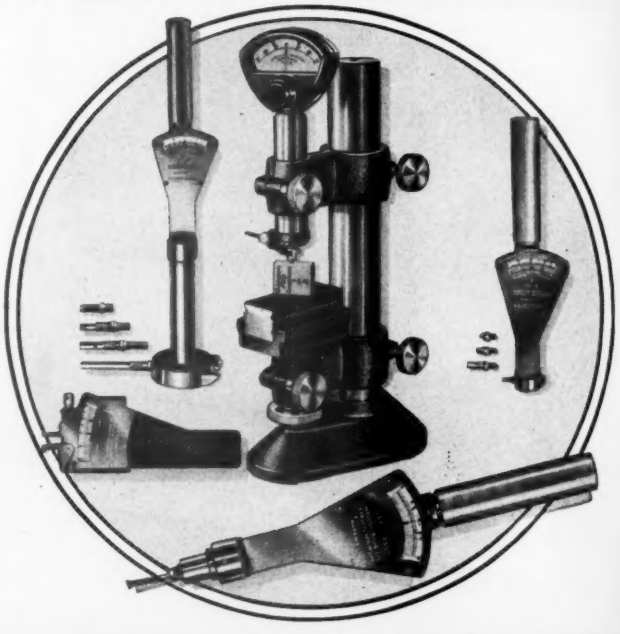

C. E. JOHANSSON GAGE CO.

8900 ALPINE AVENUE, DETROIT 4, MICHIGAN • A DIVISION OF SWEDISH GAGE CO.

(A DIVISION OF SWEDISH GAGE CO.)

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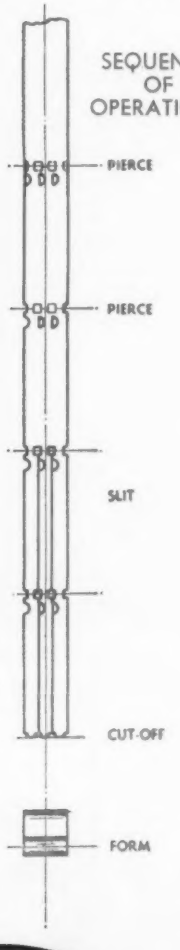
ON THIS TOP QUALITY HIGH-PRODUCTION JOB .

No. 28 U.S. MULTI-SLIDE® PAYS FOR ITSELF IN 11 WEEKS!

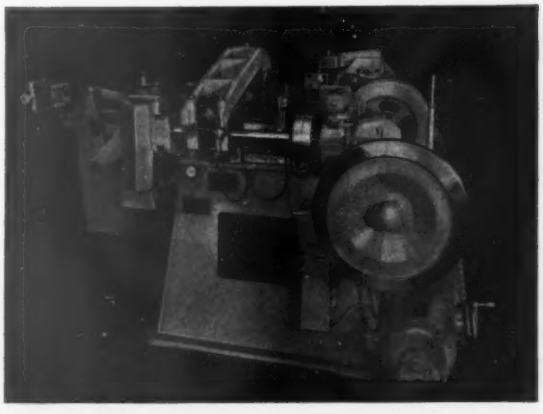
ILLUSTRATING THE VERSATILITY OF THE U. S. MULTI-SLIDE 600 PARTS PER MINUTE

The part illustrated at top, right is produced in a No. 28 U. S. Multi-Slide Machine from .016" thick phosphor bronze, and the sequence of tooling is shown in the drawing at the right. The finished part is 3/16" wide, and the material fed into the machine is 9/16" wide. This strip is sheared into three strips, from each of which a part is produced. The Multi-Slide runs at 200 strokes per minute, resulting in a production of 600 finished pieces per minute. On this job, the user wrote off an investment for a No. 28 Machine complete with tools in 11 weeks! Possibly you have similar jobs in your plant where the use of U. S. Multi-Slides will result in equivalent savings.



The design of many metal parts is such that they are particularly adaptable for production in multiples (2, 3, or even 4 at a time) in the U. S. Multi-Slide resulting in savings in material and increased production. The part shown above and the drawing at the left illustrates but one of the many different types of parts which can be produced in this manner. In all cases, the width of the material which is fed into the U. S. Multi-Slide Machine is an exact multiple of the width required for one part. The material is sheared in the machine into 2, 3, or 4 individual strips (depending on the design of the part) and one piece is produced from each strip at each stroke of the machine. On this type of operation the machine is arranged with a Positive Rear Knockout that maintains the individual strips in line after shearing, and prevents interference during the feed stroke.

Bulletin No. 15-P contains complete specifications of four sizes of U.S. Multi-Slides. Write for your copy—there's no obligation.



No. 28 U.S. Multi-Slide. Stock capacity, 1½" wide; feed length, 8". Overall size, 40"x50"x 80". Weight, 2600 lbs.

U S PRODUCTS

U.S. TOOL COMPANY, Inc.

AMPERE (East Orange) NEW JERSEY

Builders of U. S. Multi-Slides—U. S. Multi-Millers
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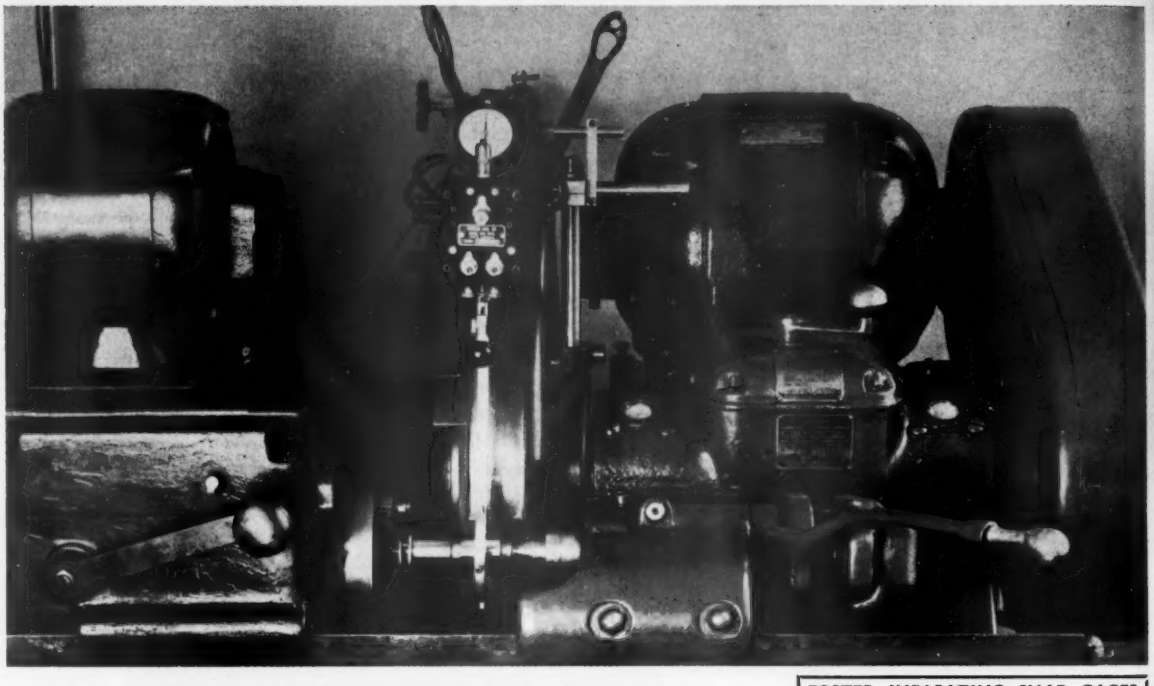

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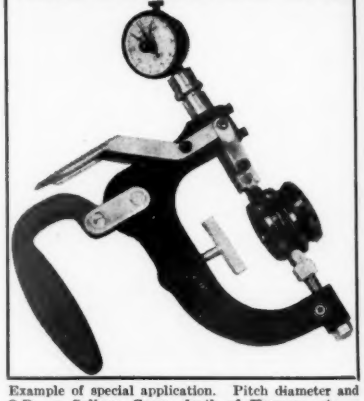

Example of special application. Pitch diameter and O.D. on Splines, Gears, depth of Keyways, etc.

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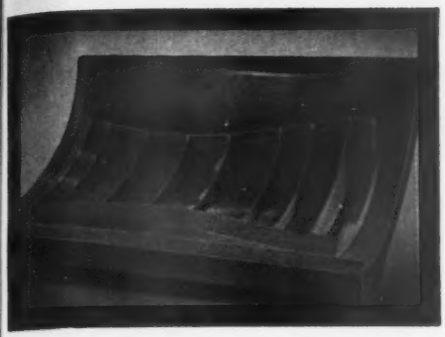

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The stylus of the pantograph is moved over the contours of the pattern, made of Marblette resin #71, reproducing it with complete accuracy in the multiple cavity steel die in the background.

This picture page shows Marblette's Phenolic Casting Resins at work for Tool and Die Men and Foundry Men who believe sound economics make the best foundation for lasting profits.

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the big business of living

We say to you who are responsible for the profitable progress of your particular enterprise, that in order to do no more than *stand still* you are going to have to *expand* your productive capacity.

We say that you are now faced with both *necessity and opportunity* for more imaginative and creative *thinking and planning* than you have ever indulged in here-to-fore.

Further, we say that you are faced also with the responsibility of converting your thinking and planning into *bold and aggressive action,* only to *maintain* that proportion of your industry's volume you now enjoy.

These positive statements are based on facts and figures which, although from several sources, were presented in a very arresting article in the September 14th issue of TIME magazine. Entitled "The Population Boom — What It Spells for Prosperity", it should be a reading must for any one having to do with production, advertising, and/or selling.

The amassed figures present a wealth of evidence that what is "boom production for a 1953 population will be far too small for a 1960 population."

While the U. S. Census Bureau, over the years, was projecting a population gain of 8,000,000 from 1940 to 1950, the *actual gain* was 19½ million to 1950's 151,700,000. Now, less than three years later, we are over 160,000,000. And, "the population is still growing so fast that it will reach an estimated 175 to 180 million by 1960." — seven short years hence.

In this period of 1940 - 1953 what have these newcomers contributed to our economy? Take just three examples given by TIME: "The U. S., which was buying baby food at the rate of 270 million cans in 1940, this year is buying it at the rate of 1½ billion cans. In the same period, the U. S. toy industry has grown from an $84 million-a-year stripling to a $900 million giant, and the sale of bicycles has almost doubled (2,000,000 last year)." It is a little difficult to imagine that anything will keep these youngsters from growing up and needing more and more goods and services.

Today there are over 63 million people at work; unemployment is only 1½ million; consumer incomes are at a record high, an estimated $285 billion for the year; and after paying taxes and accumulating record savings our people are spending at a yearly rate of over $230 billion.

This is *strong evidence* that what some have insisted upon calling a transient boom is really a level of production-based prosperity *greater than we have ever had before,* generated and sustained by *more people than we have ever had before.*

It is this *tremendous increase* in the number of people spending for goods and services that has confounded the economic forecasters, calamity howlers, and population estimators. Living has become the biggest business of all.

This, as we see it, must be the key to our plans and actions: *the unprecedented and unpredicted bigness of our peoples' living.*

What is the potential of this bigger business of living? The utilities consider that they will have to build as much capacity in the next ten years as in the past seventy-five. General Electric says "that in 1960 the growth and replacement market should mean total industry sales of 4,500,000 refrigerators v. 3,900,000 in 1951, 1,500,000 freezers v. 1,000,000, 2,500,000 ranges v. 1,400,000."

A 24,000,000 population increase by 1960 means 10,000,000 more customers of car-buying age. "All told, Congress' Joint Committee on the Economic Report has estimated, the needs for industrial expansion as well as public works will require a total expenditure of $500 billion by 1960." Public works, schools, highways, new living areas, are not just wishful thinking. General Motors has not declared itself in on the earth moving and road building equipment market just to lay out croquet courts for their employees.

What all this means in terms of additional plant, more efficient and powerful machine tools, more ingenious and productive tooling, can not be grasped by the timorous or complacent. It takes all the imagination you can muster; and *then, action.*

This all boils down to one question: Are you doing that 1953-54 planning and readying so necessary to secure even the same share of 1960's business potential that you have attained today?

E. Willard Remington

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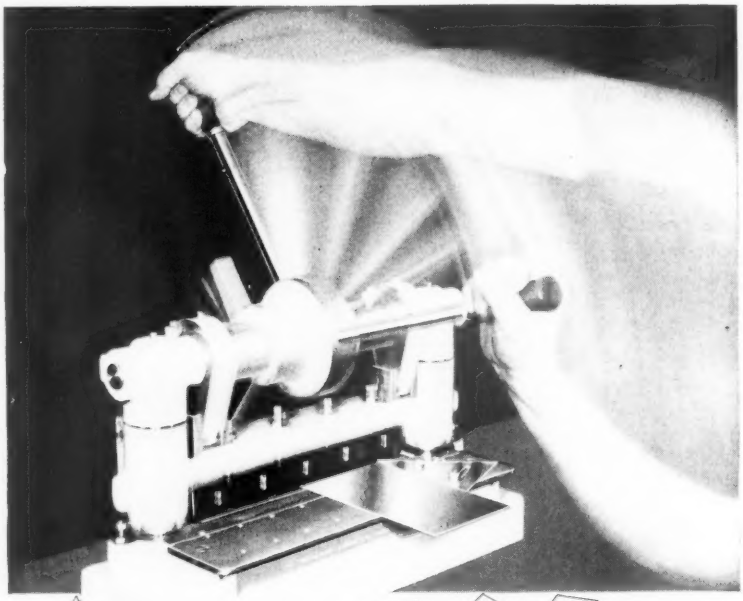
QUICK PIC CATALOGS 95
Look - - a pictorial selection of today's newest literature
Reach up on the rack - - - take your pic.

PUBLICATION PREVIEWS 102
Capsule description of current literature. Bulletins, brochures, catalogs and circulars - - - You name it!



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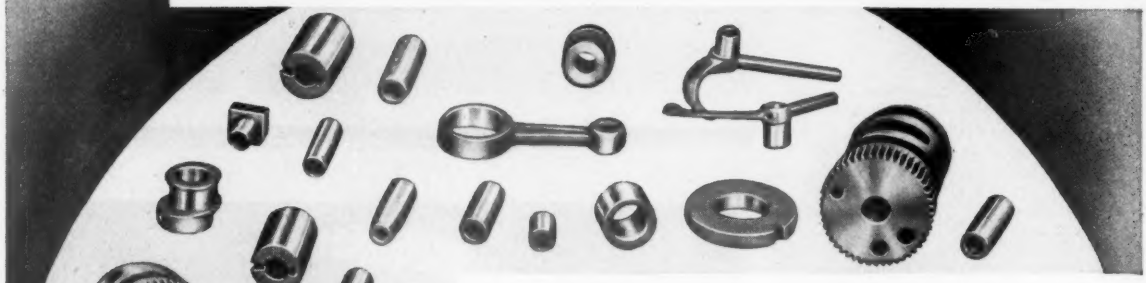
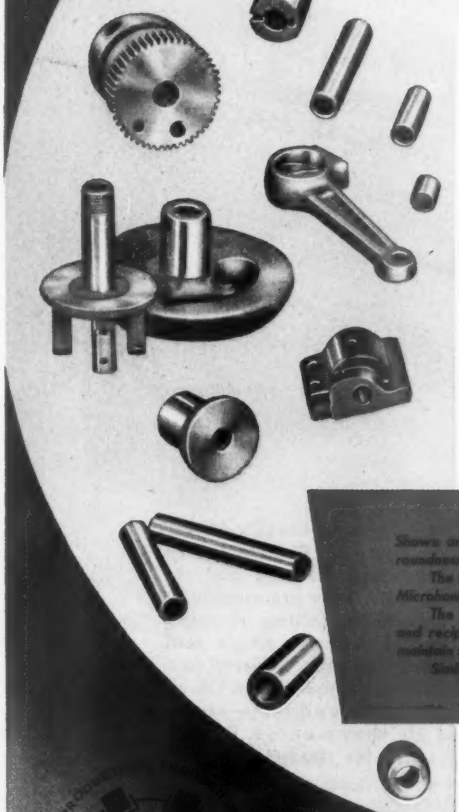
FOR PRECISION

PLUS PRODUCTION . . .

PRECIS-O-NIZING





OLD mass production methods are not enough to satisfy a market that is demanding both *quality* and *lower prices*.

Only through modern precision-production techniques can a manufacturer hope to use this two-edged sword to his own advantage!

Because of this need for a productive method of generating precision . . . the Microhoning process was evolved. For a quarter of a century the Micromatic Hone Corporation, working with industry, has led the honing field in the development of equipment that would productively finish parts within the ever-shrinking tolerances of new designs and standards.

This applied precision-adeptness of the Microhoning process is "PRECIS-O-NIZING".

In one economical operation Microhoning abrades stock rapidly and efficiently with a minimum of heat to generate—

—bores that are round and straight
—accurate diametric size
—a functional characterized (cross-hatch pattern) surface finish that is free of smeared or distorted material.

The processing of sewing machine parts is an example of PRECIS-O-NIZING.

Shown are typical industrial sewing machine parts that are Microhoned. Total tolerance for size, roundness and straightness is held to .0003 inches, or less.

The shaft bushings (needle, presser, eccentric, hook . . .) are specific applications of functional Microhoning.

The characterized cross-hatch pattern and the precision of Microhoning enable these rotating and reciprocating bushings to retain minute reservoirs of lubricating oil. At the same time, they maintain such precise fit with their shafts that a working seal is formed and there is no leakage of oil.

Similar parts are interchangeable; selective fitting of components is no longer necessary.

Microhoning equipment is available to handle all kinds and sizes of parts . . . from soft non-ferrous metals to hardened steel and special alloys . . . from .078 to 60 inches in diameter and from ¼ inches to 75 feet in length.

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QUALITY LEVEL CERTIFICATION

by Roscoe Smith
Director of Quality Control
FORD MOTOR COMPANY

WHAT IS QUALITY? It is so often found that neither the supplier of a production part nor his consumer knows by any real and consistent process of evaluation what the Quality of the purchased part really is. We may both move alertly from one Quality panic to another and therefore feel that we are staying on top of the Quality problem. . . . but are we? On the contrary, so long as we have only generalized impressions of what Quality is and vague ideas of how it can be measured, we will be completely at odds in an area which is of vital concern to us all.

Certainly it is not the desire of parts manufacturers to supply a sub-standard product. Neither is it the desire of parts purchasers to be over-exacting about things that are of no real consequence. But until supplier and consumer are able to meet on some common ground where Quality Facts guide us, rather than Quality opinions, we will continue to suffer from a mutually expensive and exasperating kind of confusion.

The point of this article is that something can be done about it. There is a tested and proven way to solve the problem of Quality confusion on purchased parts; it is Quality Level Certification, a most rewarding product of the increasingly popular science of Quality Control. Quality Level Certification answers the specific question, "What is Quality?"; it then proceeds to answer the remaining question, "How can Quality be fairly measured against this standard?" As we see it at Ford, Certification is an uncomplicated means of merging the Quality program of a supplier with that of his consumer . . . . and obviously for everybody's benefit. Our experience with over 400 Certifications, and that of other companies following the same general idea, proves the point. A similar internal program at Ford involves Certification between our own plants, one in the role of supplier and the other in the role of consumer. The responsibility for Quality evaluation is thus firmly placed at the manufacturing source, where it can be of maximum benefit. In the overall, the Company then enjoys the advantage both of improved Quality and increased Quality assurance with less total inspection effort.

Training sessions acquaint interested supplier personnel with various phases of Quality Control and methods of correlating inspection procedures.

But perhaps before we go into detail on Certification it would be helpful to consider why Quality is, itself, becoming a matter of such dominant importance. Why, for instance, is the new science of Statistical Quality Control getting so much attention?

Over the years, there has been a gradual drift toward the design of increasingly complicated products to meet what are often quite simple human needs. Competition is the keyword. Whether it is alarm clocks or kitchen ranges, to be competitive, the manufacturer must furnish much more grace, comfort and utility than is fundamental to the basic operation of telling the time of day or cooking the potatoes. If he lets up on the advancement of design and does not find cheaper ways of making the product, and of making it better, he loses his shirt. That is America . . . . and coupled with a peerless system for creating the desire for better things, it is a principal factor in the development of the world's greatest production machine.

But with this most desirable advancement in functional design and the technology to satisfy it, we fall heir to many new and very tough problems, one of which is most assuredly Quality. The answer heard from increasing numbers of progressive firms is to use the scientific approach, Statistical Quality Control, or plain Quality Control as it is more often called.

Now Vendor Quality Level Certification moves into prominence as a sort of by-product of this new and developing science of Quality Control. It fills a long-felt need which has pressed equally upon the suppliers and consumers of production parts for much too long a time. This is the simple need for more adequate understanding of one another in the entire matter of Quality.

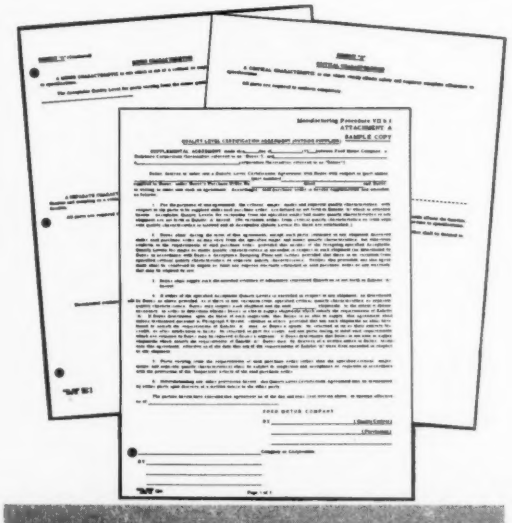

Fig. 1. The Quality Level Certification Agreement establishes the terms by which Quality will be determined.

And the greatest single impediment to the development of this understanding has been the lack of facts. It has been the lack of a concrete, mutually established and fully understood Quality Goal. It has been the consequent lack of a consistent system for Quality evaluation, with respect both to the consumer's incoming product inspection and the supplier's outgoing product inspection — traditional efforts at 100% inspection notwithstanding.

At the Ford Motor Company, the Quality of our finished products, automobiles, trucks, tractors and defense items, depends to a very critical extent on the performance of thousands of suppliers. If any of the incoming purchased parts are of poor Quality, then there is some likelihood that even the best inspection effort will fail to prevent some defectives from reaching the field. This is a most serious problem, and recognizing it Ford must employ the soundest economic method at our command to hold field defectiveness at an absolute minimum. Our solution is accomplished in part through the use at Receiving Inspection of the Ford Acceptance Sampling Plan, a sampling system derived from the Joint Army-Navy Standard-105 some four years ago. It figures importantly in our approach to Certification and will later be considered in some detail.

What we have said to this point has been for the particular purpose of describing the framework into which Certification has been introduced. It is an attempt to show first, that there is a need and second, that the logical solution for the need can only be a joint enterprise in which consumer and supplier share equally.

In brief, the Quality Level Certification Agreement (Figure 1) is an attachment to the purchase contract. In the Agreement our supplier proposes to furnish at intervals simple documented assurance that each of his shipments of a given supply meets a mutually established Quality Level with respect to certain designated characteristics. As will be seen, it differentiates between the important and the unimportant characteristics of the part or assembly. It brings mutual emphasis to the particular dimensions and other features of a part which most directly bear on the Quality of that part in further processing or in ultimate use. It sets forth in clear terms what the individual part must be like, in the

Fig. 2. A pre-certification meeting between representatives of the supplier and of the consumer division provides opportunity for cooperative development of mutually acceptable Quality determinants.

main, if either the supplier or the consumer is to judge it acceptable. Finally, it establishes, by agreement, the amount of defectiveness which, on the average, both the supplier and the consumer would consider reasonable in successive lots of material.

The negotiation of a Certification Agreement starts with our Purchasing people. Upon the supplier's expression of interest, Purchasing arranges a pre-certification meeting (Figure 2). Present are representatives of the supplier's Sales, Quality Control and Production organizations, together with people from the consumer division's Purchasing and Quality Control departments. The actual development of a Certification takes form in the following general stages. This is where Quality facts begin to have substance:

1. Select the Characteristics Contributing Significantly to Quality

These are the items of specification or blueprint which determine first, whether the part will "build" into the assembly and second, whether it will faithfully meet functional requirements. We aim for joint concentration and emphasis on those attributes and only those which make or break Quality. This cannot be stressed too much. The inclination to "fly-speck" in the assumption that nothing can then escape us is unrealistic. It has no place in Certification because it necessarily means sacrifice of concentration on the main Quality determinants.

2. Classify the Selected Characteristics as Critical, Major, Minor and Separate

This is done according to the following definitions and in a further effort to be realistic about our emphasis:

A Critical characteristic is one which vitally affects safety and requires complete adherence to specifications.

A Major characteristic is one which is not of a critical nature, but significantly affects the function, effectiveness, utility life or appearance of the product, and requires a high degree of adherence to specifications.

A Minor characteristic is one which is not of a critical or major nature, but involves general adherence to specifications.

A Separate characteristic is a chemical, metallurgical or other property which does not permit classification and sampling as a critical, major, or minor characteristic because of restrictive methods of analysis and verification.

3. Negotiate Acceptable Quality Levels for Each Class of Characteristics

The acceptable Quality levels are negotiated on the basis of what the supplier can reasonably be expected to produce and what the consumer can reasonably afford to absorb. Critical characteristics, for instance, are held to 0% defective, since they involve safety and are by definition to be completely perfect. Major characteristics may be held in the region of ½% or 1% defective, and Minors in the region of 2 to 6% depending on the nature of the part, the effect sub-standard Quality would have on the customer and the possible expense involved in repair. To expect perfection on all characteristics would be foolhardy, even though one might wonder why it could not be attained. Certainly, perfection is the ultimate objective of every manufacturing process, but

. . . *Continued on page 170*

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Fig. 2. A pre-certification meeting between representatives of the supplier and of the consumer division provides opportunity for cooperative development of mutually acceptable Quality determinants.

main, if either the supplier or the consumer is to judge it acceptable. Finally, it establishes, by agreement, the amount of defectiveness which, on the average, both the supplier and the consumer would consider reasonable in successive lots of material.

The negotiation of a Certification Agreement starts with our Purchasing people. Upon the supplier's expression of interest, Purchasing arranges a pre-certification meeting (Figure 2). Present are representatives of the supplier's Sales, Quality Control and Production organizations, together with people from the consumer division's Purchasing and Quality Control departments. The actual development of a Certification takes form in the following general stages. This is where Quality facts begin to have substance:

1. Select the Characteristics Contributing Significantly to Quality

These are the items of specification or blueprint which determine first, whether the part will "build" into the assembly and second, whether it will faithfully meet functional requirements. We aim for joint concentration and emphasis on those attributes and only those which make or break Quality. This cannot be stressed too much. The inclination to "fly-speck" in the assumption that nothing can then escape us is unrealistic. It has no place in Certification because it necessarily means sacrifice of concentration on the main Quality determinants.

2. Classify the Selected Characteristics as Critical, Major, Minor and Separate

This is done according to the following definitions and in a further effort to be realistic about our emphasis:

A Critical characteristic is one which vitally affects safety and requires complete adherence to specifications.

A Major characteristic is one which is not of a critical nature, but significantly affects the function, effectiveness, utility life or appearance of the product, and requires a high degree of adherence to specifications.

A Minor characteristic is one which is not of a critical or major nature, but involves general adherence to specifications.

A Separate characteristic is a chemical, metallurgical or other property which does not permit classification and sampling as a critical, major, or minor characteristic because of restrictive methods of analysis and verification.

3. Negotiate Acceptable Quality Levels for Each Class of Characteristics

The acceptable Quality levels are negotiated on the basis of what the supplier can reasonably be expected to produce and what the consumer can reasonably afford to absorb. Critical characteristics, for instance, are held to 0% defective, since they involve safety and are by definition to be completely perfect. Major characteristics may be held in the region of ½% or 1% defective, and Minors in the region of 2 to 6% depending on the nature of the part, the effect sub-standard Quality would have on the customer and the possible expense involved in repair. To expect perfection on all characteristics would be foolhardy, even though one might wonder why it could not be attained. Certainly, perfection is the ultimate objective of every manufacturing process, but

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QUALITY CONTROL IN THE RECEIVING DEPARTMENT

by Joseph J. Manuele, Director
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THE QUESTION is often asked: "How is quality **controlled** in the receiving department?" And the correct answer is: "Quality is not controlled in the receiving department."

The inspector passes products of the same quality as are submitted for inspection. He may, on occasion, reject products which fail to meet the prescribed specifications. However, the products that he does pass are not improved by the inspection operation. Therefore, except for whatever pressure can be brought upon the supplier to improve his operations and thereby improve quality, inspection of products in the receiving department does not improve or control the quality of such products.

The problem therefore resolves into the question of how an inspector can decide quickly and reliably whether to accept or reject a lot or block of parts. The solution is sampling inspection. Since the inspector's decision must be governed by how the products measure up to the prescribed standards of quality, sampling becomes the economical method.

The inspector takes a small sample of the lot received and inspects this in the regular way. Inspection may be by the method of attributes or the method of variables. Whatever the statistical method, a decision must be made: does the sample meet the previously determined condition for acceptance or not? These "previously determined" conditions are governed by the acceptable quality level, and the quality standards established for the product.

Generally speaking, sampling has been an accepted procedure for determining the quality of liquids and such bulk items as ores, sand, coal, and other materials generally handled in bulk. However, for some unexplained psychological reason there is a reluctance to accept sampling as a proper basis for judging the quality of lots made up of integral units. Perhaps it's the fear of inhomogeneity since the argument most generally advanced says: "We do not know anything about the items we have not inspected." Strangely enough, this argument is put forth by the statisticians themselves.

However, sampling is a perfectly reliable method for evaluating the quality of a lot or block of items provided the sampling is done

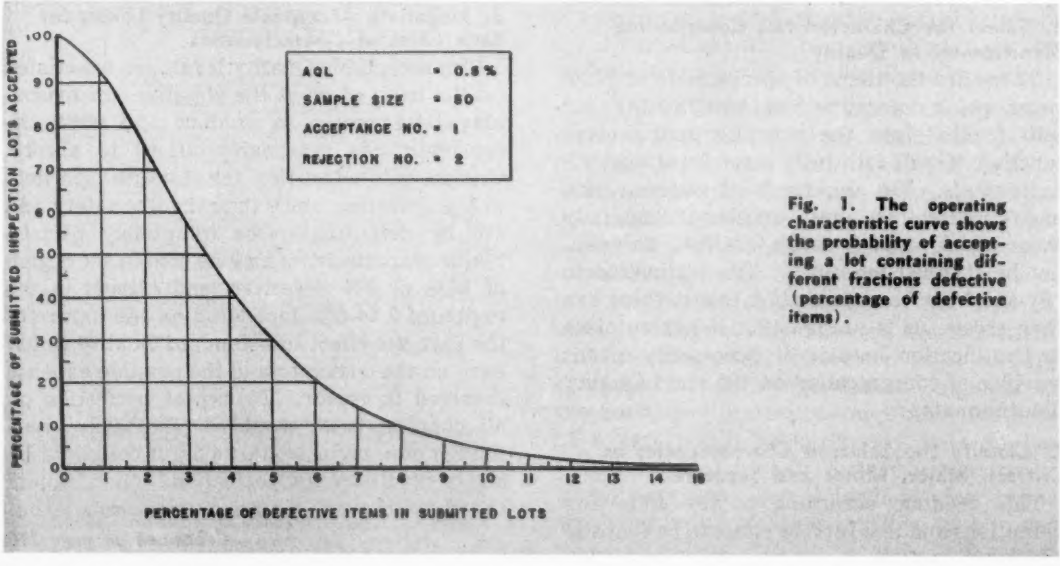

Fig. 1. The operating characteristic curve shows the probability of accepting a lot containing different fractions defective (percentage of defective items).

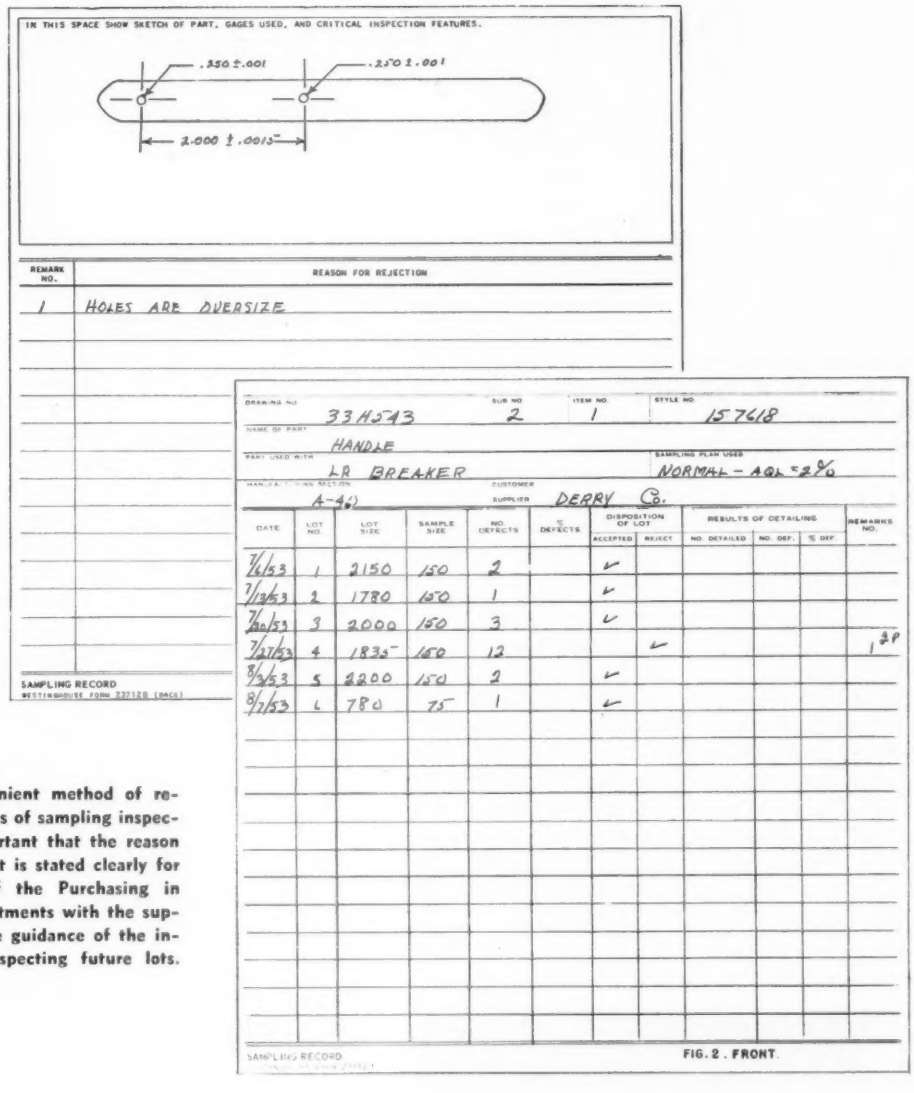

Fig. 2. A convenient method of recording the results of sampling inspection. It is important that the reason for rejecting a lot is stated clearly for the guidance of the Purchasing in negotiating adjustments with the supplier, and for the guidance of the inspector when inspecting future lots.

in accordance with accepted and proven procedures. Sampling is based on the laws governing the behavior of large numbers. The uniformity of behavior characteristic of the stability of large numbers enables the inspector to say with a fair degree of certainty that the sample represents the entire lot or block. This "fair degree of certainty" may be made as reliable as desired by varying the sample size and the acceptance number.

This law governing the behavior of large numbers may be expressed mathematically as:

$$(q+p)^n = q^n + \frac{nq^{n-1}p}{1} + \frac{n(n-1)q^{n-2}p^2}{1\cdot 2} + \ldots + p$$

where:

p is the fraction defective in the lot. This figure multiplied by 100 is equivalent to the per cent defective

$q = 1 - p$

n = number of units in the sample.

When this expression is expanded the first term, q^n, will represent the probability of finding no defective units in the sample; the second term, $\frac{nq^{n-1}p}{1}$, is the probability of finding one defective unit in the sample, and so on. This enables the inspector to estimate the probability of finding a specified number of defectives in a sample when the sample size and the probable fraction of defective items are known.

However, the inspector must know more about the subject of sampling than the probability of finding any particular number of defectives in the sample. He must understand

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Quality Control in the Press Room

by Lester F. Spencer
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THE ESTABLISHMENT OF A QUALITY CONTROL program in a press room, in which literally thousands of various sizes and shapes are produced, requires not only a planned program which is of sufficient flexibility, but also trained personnel to operate this program on a sound basis. Thus, the variety of operations, that is so characteristic of any press room, requires a flexible program so as to satisfy the needs of each individual part whether it be a drawn shell, an armature lamination punching or a part which first has been spun to shape.

The inspection personnel should be trained not only in respect to the basic requirements of the specific part as set by a standard or specifications, but should also be familiar with the specific function of the part within an assembly, have a knowledge of the subsequent operations required to obtain the completed part, and be able to realize the "cause and effect" in relationship to the results obtained from a known defect regardless whether this defect is caused by a weakness of raw material or by an operational procedure.

At Landers Frary and Clark, this planned program has been established in two major press rooms, each of which covers an approximate area of about 24,000 square feet and, in addition, it is also in operation in several smaller auxiliary press rooms. Although the program has been in operation only four years, the progress that has been made is indeed encouraging. The major advantages that have been realized by the installation of this quality control procedure include, (a) a decrease in defectives as indicated by the reduction in both scrap and re-work along with the increase of acceptable goods; (b) an increase in the outgoing quality level on semi-finished goods destined for additional operations; and, (c) a resultant decrease in manufacturing costs. In addition, increasing the quality level in basic manufacturing operations, such as in the press room, is indeed reflected in the quality level of the completed item.

Courtesy, The Cincinnati Shaper Co.

Fig. 1. Drawn parts as illustrated are followed closely to maintain dimensions.

However, it can be stated that the establishment of a quality control program within the press room, or, as a matter of fact, in any division of a company where basic forming operations are performed, is not an easy matter. Based on an objective of the reduction in defectives, the initial steps in the establishment of this program included, (a) the acceptance and cooperation of both the foreman and the press operators; (b) the evaluation of existing equipment so as to determine the quality level capability; (c) the correlation between existing specifications and equipment capability; and, (d) the correlations of facts obtained with the aid of the various specialists within the company.

The Raw Materials

As in many procedures which involve the movement of raw material to a basic forming operation, the quality level of a press formed part is largely dependent upon the quality level of the raw material, whether it be sheet, strip, wire or tubing. This demands that the initial step in a sound and operable quality

control program be the adequate control of incoming raw material. In many instances, the quality limits of inspection are based on specifications which have been formulated by experienced materials engineers.

The importance of material specifications cannot be over-emphasized since, in many instances, these specifications will determine whether the material is either acceptable or rejectable. In many instances, the establishment of a material specification may be based on a standard such as the A.I.S.I. (American Iron and Steel Institute) standards, thus indicating the desired value of those variables of temper, edge condition and finish; these values being placed on the part print.

This simplified procedure is invariably true in the event that a material such as carbon steel strip is purchased; the specific values of these three variables being selected to suit the severity of the operation, the quality level of the specific part and the end purpose of the formed part.

In the event that a sheet or strip material requires a special quality classification, the specification for the incoming raw material is usually in greater detail and should be written in conjunction with a representative of the supplier of the raw material. This suggested procedure will place a specification on a sound basis since (a) the consumer will realize the quality level capability of a supplier in obtaining a material which will satisfactorily make the part, and, (b) the supplier will thoroughly understand the quality requirements and the difficulties associated in fabricating the material purchased. In addition, a specification which has been formulated in this mutual manner, will assure the continuous supply of a high quality product.

Examples of conditions which necessitate a special quality classification would be a sheet material that requires specific properties so as to permit a severe reduction upon press forming. This fact, in combination with the requirement of relative freedom from age hardening, would indicate the usage of an aluminum killed steel. However, the limitations of this type of material should be known to the consumer, particularly as to the poorer surface condition which prevents its use, to a large extent, for any exterior parts which are to be decoratively plated.

Another instance where a specialty requirement may be necessary is in the event that the characteristic of "earing," as experienced in press drawing, would be objectionable. In the event that a carbon steel sheet or strip is

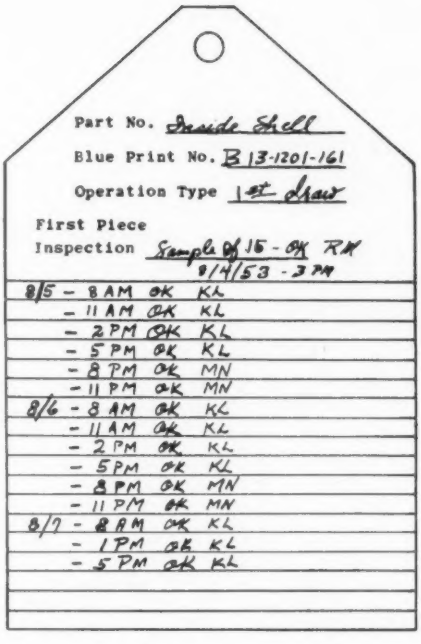
Part No. Inside Shell
Blue Print No. B 13-1201-161
Operation Type 1st Draw
First Piece
Inspection Sample of 15 - OK RM
8/4/53 - 3 PM
8/5 - 8 AM OK KL
- 11 AM OK KL
- 2 PM OK KL
- 5 PM OK KL
- 8 PM OK MN
- 11 PM OK MN
8/6 - 8 AM OK KL
- 11 AM OK KL
- 2 PM OK KL
- 5 PM OK KL
- 8 PM OK MN
- 11 PM OK MN
8/7 - 8 AM OK KL
- 1 PM OK KL
- 5 PM OK KL

Fig. 2. First-piece inspection tag.

selected as the base material, a "non-scalloping" requirement would be of necessity. In the event that an aluminum base alloy sheet is purchased, "earing" is eliminated by the selection of a composition which is guaranteed by the supplier.

The necessity for determining the quality level of incoming material is usually accepted. However, the extent of test procedures required in determining this quality level will vary with such factors as, (a) the specifications to which the material has been purchased and which are based on a specific quality level; (b) the material type and extent of forming to be performed; (c) the required quality level of the end product; and (d) the quality level of previous shipments obtained from a specific supplier from whom material has been purchased.

In many instances, the quality check on incoming stock may be at a minimum where a quality level certification is obtained from the supplier. This may be in the form of a certified chemical, physical or mechanical property check representative of the specific heat from which the material had been produced. Thus, in the event that a stainless steel has been purchased, the essential control variable is its corrosion resistance; this factor being determined as either acceptable or rejectable on the basis of its chemical composition. In the event that a silicon electrical steel has been purchased, a certification in regard to its electrical properties would be of importance.

Report No.

Part Name LEVER BAR Insp. Method DIAL INDICATOR Sample Size 50 to 60

Part No. C10-1103-261 Spec. Limits 2 9/16" ± 0.010 Inspector KMR

Operation CUT TO LENGTH Process Limits 2.552-2.572"

	7/6 8:00 AM	7/6 11:00 AM	7/6 1:00 P.M.	7/6 3:00 PM	7/6 5:00 PM
2.548			✓		
.549				✓	
.550	✓		✓✓		
.551	✓	✓✓✓	UPPER LIMIT		
.552			✓		
.553			✓✓		
.554	✓✓✓✓✓	✓	✓✓✓✓		
.555	✓✓		✓✓✓✓		
.556		✓✓			
.557	✓✓✓✓✓✓	✓✓✓	✓✓✓✓✓✓✓		
.558	✓✓	✓	✓✓✓✓✓✓✓✓	✓✓✓	
.559	✓✓✓✓✓	✓✓✓			
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.561	✓✓✓✓✓✓✓✓	✓✓✓✓✓✓	✓✓✓✓✓✓	✓✓✓✓✓✓	
.562	✓✓✓✓✓✓✓✓✓✓	✓✓✓✓✓✓✓✓✓✓	✓✓✓✓✓✓✓	✓✓✓✓✓✓✓✓✓	
.563	✓✓✓✓	✓✓✓✓✓✓	✓✓✓	✓✓✓✓✓✓	
.564	✓✓	✓✓✓		✓✓✓	✓✓✓
.565		✓✓✓		✓✓✓✓	✓✓✓✓✓
.566	✓	✓✓✓		✓✓✓✓✓	✓✓✓✓✓✓
.567			✓	✓✓✓✓✓	✓✓✓✓✓✓✓
.568		✓		✓✓✓✓	✓✓✓✓✓✓✓
.569	✓	✓			✓✓✓✓✓✓✓
.570					✓✓✓✓✓✓✓
.571					
.572					
.573		LOWER LIMIT			
.574		✓			Determine
.575	OK	OK	OK	OK	cause
.576		✓			of
.577					Drift

Fig. 3. Typical frequency chart used to advantage in quality control. A concentration of pieces reading close to the dimensional limit requires action to determine cause of the drift and the point at which it should be corrected.

Obtaining a certificate of quality level of material purchased does not indicate that test procedures be abandoned. Thus, an accepted procedure is to determine the quality level of the first shipment and as the reputation of the supplier for high quality goods increases, the testing of incoming shipments may be less frequent, say once in every six to eight shipments. It is usually good practice to maintain a chart system as to the incoming quality levels of purchased materials; this chart system being quite significant where a specific material is purchased from two or more different sources. This has been done on material purchased for appliance parts which must be vitreous enameled; the quality level history of several companies, as indicated by the chart system, determining those suppliers from whom the bulk of the material should be purchased.

As previously stated, a complete understanding between the supplier and the consumer of raw materials must be realized; this being true not only in regard to the content of a specification, but also, on the method of test procedure to be employed in determining the quality level of the variable. In a specific example, a minimum hardness of Rockwell C38 had been placed as a requirement on pretempered strip; the material being a stainless composition, type 410, which was to be used as a spring. The material shipped, in which the supplier had obtained a hardness of C40 by using the 30 kilogram loading on a superficial Rockwell hardness tester, was rejectable at the consumer plant since a hardness reading of C36 had been obtained by using a 60 kilogram loading on a standard model Rockwell hardness testing machine. Thus, a dispute as to the acceptability of the material was created due to the fact that the conditions under which the hardness test would be performed were not specified.

Although dimensional tolerance is often the basis of acceptance or rejection of materials, the metallurgical, chemical and electrical test laboratories play an important role in determining acceptability. Thus, the procedure of test along with the frequency of testing is depended upon (a) the specific variable used as the acceptance basis; (b) the quality level given for acceptance for the specific variable or variables; and, (c) the recorded quality level of the individual supplier as obtained throughout the years.

Established Procedures

To adequately control parts in process, the press room is divided into sections; each section being serviced by a qualified and well trained inspector. In addition, an inspector is stationed at raw material storage who has control over the millions of pounds of materials that flow through the department yearly; a variety of materials includes stainless steels, low carbon deep drawing steels, silicon elec-

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The Application of Statistical Quality Control Techniques to Experimentation

by Frank Caplan, Jr., Supervisor
Process Quality Control
Syracuse Manufacturing Operations
GENERAL ELECTRIC COMPANY

I THINK IT WOULD BE DESIRABLE first to discuss statistical tests in general so that we can get some idea of what these techniques are and how they can be used. The tests ordinarily used in experimentation are called variance analysis and correlation. Variance analysis is a study of the variability of the process. Breaking down a total variability into its components, we can ascribe the actual numerical value of variability to each element in the process.

These elements are known as factors, and it is our purpose by means of controlled experimentation to determine the relative importance of these factors and whether or not their effect upon the total variability of the process actually exists. Correlation is that subject which treats of the relationship between two or more variables. By this means we are enabled to reduce this relationship to an actual formula, showing the dependency of one variable upon another or upon several others. This enables us to forecast the effect of future changes.

Although the tests themselves are simple, it is necessary to design our experiments in such a way that we will obtain the answer to the question that we want without bias and without introducing the effect of other factors which we might not recognize. What I mean by this is that we want to have an experiment which will show the effect of only those factors which we are interested in studying. The effect of any other factors should be minimized and, where they cannot be eliminated, should be forced into the error term so that they do not change the actual effect of some factor which we are interested in studying.

There are many other statistical tests which are used for one reason or another in industrial experimentation. The two that I have stated are frequently the ones that are used for the results of experimental testing.

This article has been adapted for publication from a paper presented at the September 1953 meeting of the National Electronics Conference.

For the purposes of this discussion we will talk only about variance analysis. The important concept of this technique is that it sets up a mathematical condition such that the sum of the variabilities of all the factors entering into the process are equal to the total variability of that process. As I stated earlier, one of the important problems to be solved in setting up the proper design of an experiment is to force all bias into the error term. This can best be done by a technique which is known as randomization.

A formally randomized experiment is one in which all factors entering into the end result, which are not actually part of the experimental design itself, have been forced into the error term by making their occurrence fall in a chance pattern rather than in a biased one. Formal randomization implies the ability to control the effect of the various factors, and this is sometimes impossible. For example, it is often very difficult to control the ambient air temperature in a space which is not air conditioned. In this case we must note the variation of these factors where we deem them to be important during the course of the experiment, thus enabling us to determine afterwards by analysis whether or not these variations had an important effect upon the end results.

Usually the question on the choice of the proper design for an experiment hinges upon a decision as to whether you wish to have the greatest amount of information about the process, or whether you wish to have instead the least expensive experiment to give you as much information as you can get. Since most processes have a large number of factors affecting their total variability, it is frequently necessary to compromise these two positions. This is frequently done by running so-called

		A		
		1	2	3
B	4	C8 D12 (1) (3) (3)	C9 D10 (4) (5) (6)	C7 D11 (7) (8) (9)
	5	C9 D11 (10) (11) (12)	C7 D12 (13) (14) (15)	C8 D10 (16) (17) (18)
	6	C7 D10 (19) (20) (21)	C8 D11 (22) (23) (24)	C9 D12 (25) (26) (27)

Fig. 1. Graeco-Latin Square showing 3 replicates per cell.

19	7	13	1	10	2	4	17	16
9	6	3	11	21	12	20	22	5
15	14	23	26	27	24	18	25	8

Fig. 2. Random order of 27 Experiments.

fractionally replicated experiments in an initial series to eliminate certain of the variables which may or may not have an important effect.

This experiment, or these experiments if there have to be several, is then followed by what is known as a full factorial experiment yielding information not only about the main factors themselves but also about the effect of their relationship, one with another. This latter effect is given the name interaction, and, if it exists in a variance analysis, it is an indication that there is a correlation between these two factors which unite in some manner to force an effect upon the final process which neither could give alone.

In the particular problem which I shall describe most of these principles will be demonstrated. I shall not divulge the nature of the actual process involved, since what we are interested in is the application of statistical techniques. These can be applied to any problem, whether it has a few factors such as this one has, or whether it has a large number.

DATA OF EXPERIMENT I

		A								
		1			2			3		
B	4	89	95	94	100	107	100	91	85	88
	5	101	97	101	117	117	118	105	105	110
	6	105	101	102	109	112	111	101	111	100

$$\Sigma X^2 = 286642$$

$$\frac{(\Sigma X)^2}{27} = \frac{(2772)^2}{27} = \frac{284592}{2050}$$

CELL SUMMATION - EXPERIMENT I

		A		
		1	2	3
B	4	C8 D12	C9 D10	C7 D11
		278	307	264
	5	C9 D11	C7 D12	C8 D10
		299	352	320
	6	C7 D10	C8 D11	C9 D12
		308	332	312

$$\frac{\Sigma(A)^2}{3} = \frac{859366}{3} = 286456$$

SUM OF SQUARE CALCULATIONS - EXPERIMENT I

		Σ		
A	1	885	$\frac{\Sigma^2}{9} = \frac{2568122}{9}$ =	285347
	2	991		-284592
	3	896		755
B	4	849	$\frac{\Sigma^2}{9} = \frac{2569946}{9}$ =	285550
	5	971		-284592
	6	952		958
C	7	924	$\frac{\Sigma^2}{9} = \frac{2561400}{9}$ =	284600
	8	930		-284592
	9	918		8
D	10	935	$\frac{\Sigma^2}{9} = \frac{2562614}{9}$ =	284735
	11	895		-284592
	12	942		143

SUMMARY OF VARIANCE

Source	Σ Squares	df	Mean Squares	F Ratio
A	755	2	378	36.7^{xxxx}
B	958	2	479	46.5^{xxxx}
C	8	2	4	.4 not significant.
D	143	2	71.5	6.9^{xx}
Residual	186	18	10.3	
Total	2050	26		

Fig. 3. Analysis of Experiment I.

I was brought into this problem by one of our Design Engineers who came to me to discuss a process which he was developing. He wished to know whether or not his process was better than the one currently in use in the factory operations and, also, what the optimum levels of the various factors would be in order to produce the best final product. In the course of my discussion with him, we determined that there were seven principle parameters which had to be controlled in order to operate the process.

For purposes of discussion I shall label these factors A, B, C, D, E, F and G. Now although it is possible to run a full factorial experiment with any number of factors, as you increase the number of factors the total number of combinations which have to be tested mount on an exponential curve. If, for example, each of these seven factors were at three levels, the total number of combinations which they would make would be three to the seventh power or 2,187. Since we normally replicate or repeat an experiment more than once, if we were to run this three times it would mean over 6500 experiments would have to be run. This is prohibitive. Therefore, in order to save money and time, we decided to run some preliminary experiments.

To this end I designed a Graeco-Latin square which is one of the foremost examples of the fractionally replicated design. This concerned the factors A, B, C and D, each of which were at three levels, and was designed as in Figure 1. As you can see, this experiment was replicated three times, thus requiring a total of twenty-seven experiments.

The numbers in the body of Figure 2 are the order of experimentation and designate the cell numbers shown in Figure 1. The order of this experimentation and the placing of these numbers in the table was determined by consulting a table of random numbers where we chose from the table only those numbers between one and twenty-seven. Other methods of randomization may be used. Twenty-seven cards could be selected at random or the spots could be counted on the successive throws of four dice. I have no quarrel with any method except that a random number table is more likely to yield truly random distributions of numbers.

The resultant data from this experiment are given in Figure 3 as is the resultant analysis.

By this simple and inexpensive test we were able to select an optimum value of factor A, a probable optimum for factor B, a decision that factor C had no effect upon the final result and therefore could be standardized at some easily controlled level, and no decision on factor D. This meant that factor D would have to be included in some later design. It was therefore decided to design Experiment 2, which was a full factorial design comparing factors D, E and F. We chose a full factorial because we suspected that certain interactions might exist. If we were to use a Latin square and these interactions did exist, they would cause false results to be obtained.

D	1								
E	4			5			6		
F	7	8	9	7	8	9	7	8	9
R	108	119	113	106	108	127	89	105	98
E	110	109	102	115	112	111	109	103	114
P.	107	113	105	90	106	49	118	114	34
Total	325	341	320	311	326	287	316	322	246

D	2								
E	4			5			6		
F	7	8	9	7	8	9	7	8	9
R	116	112	109	121	101	117	115	112	113
E	113	116	117	113	106	108	113	104	113
P.	113	110	114	119	113	116	115	89	75
Total	342	338	340	353	320	341	343	305	301

D	3								
E	4			5			6		
F	7	8	9	7	8	9	7	8	9
R	112	113	116	114	118	116	114	112	114
E	109	111	114	111	114	112	110	107	111
P.	107	113	114	108	104	105	98	114	113
Total	328	337	344	333	336	333	322	333	338

Fig. 4. Experiment II design.

Figure 4 shows the design of Experiment 2. Each of the three factors are at three levels and we have replicated three times. The numbers in the body of the table are the randomized order of experimentation obtained in the same manner as those for Experiment 1.

D	1								
E	4			5			6		
F	7	8	9	7	8	9	7	8	9
R	19	7	13	32	1	29	10	43	2
E	40	55	35	64	15	38	14	45	39
P.	72	60	73	79	70	65	66	69	76

D	2								
E	4			5			6		
F	7	8	9	7	8	9	7	8	9
R	4	17	47	16	9	6	3	63	46
E	23	26	74	28	41	27	44	24	56
P.	58	31	80	33	54	77	48	81	67

D	3								
E	4			5			6		
F	7	8	9	7	8	9	7	8	9
R	11	42	21	12	52	20	22	53	5
E	18	49	36	34	68	25	30	59	8
P.	51	78	62	57	61	75	50	71	37

Fig. 5. Data of Experiment II.

Figure 5 shows the data of the experiment arranged in the same form as the design, with the actual data coded and placed in the body of the table.

Figure 6 gives the details of the analysis of the experiment. It shows the three two-way

. . . Continued on page 68

PROVIDING INCENTIVES FOR IMPROVED QUALITY

The use of control charts for fraction defective has reduced defects in an electron tube assembly department.

by H. Dean Voegtlen
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AMONG the very early uses of Statistical Quality Control in manufacturing were applications of the Shewhart Control Chart for average and range. These were used largely on machining operations where there were one or more critical dimensions such as a diameter, length or thickness measurement. Assignable causes of variation arising from tool wear, faulty machine adjustments, or improper material were effectively revealed and corrected with the help of the control chart. Because of the automatic nature of most of these operations, variations were caused mainly by machines or materials. Where job training was adequate, the machine operator contributed only a small part to the total product variability.

QUALITY CONTROL -- MOUNT DEPARTMENT
TYPE 6098 DATA SHEET November 1952

Date:	3	4	5	6	7	10	11	12	13	14	17	18	19	20	21	24	25
Number of mounts inspected	50	50	50	50	45	50	55	45	50	50	50	50	50	50	45	50	50
Percent defective	16	26	6	18	24	14	7	8	4	16	6	4	8	4	2	8	4
A. Defective welds:																	
1. Half plate			/		/												
2. Cathode tab to beam plate ear and support	/								/	/						/	
3. Connector to #1 grid or lead		/					/	/					/				
4. Connector to #2 grid or lead	/				/	/											
5. Stem leads to filament		/															
6. Grid bracer to #2 grid																	
7. Eyelets to supports																	
8. Stem leads to supports																	
9. Radiator	//	///	/	///	///	//	//	/		//	/						
10. Getter																	
B. Shorts:																	
1. Heater to heater or cath.				/													
2. Grid to grid		/		/	/	/				/							
3. Heater to grid	/	//	/	//		/				/	/		/	/			/
C. Splash welds																	
D. Mica - peeling																	
E. Mica - poor spray					/			/									
F. Filament - chipped	/	//		/		/			/	/	/		/			/	
G. Filament - alignment		/															
H. Grid - alignment																	
I. Grids - bowed																	
J. Grids - pushed turns	//	/		/	////	/	/	/		//		//	/	/	/	//	/
K. Close wires		/															
L. Glass defects																	
M. Mount - alignment																	

FIGURE 1

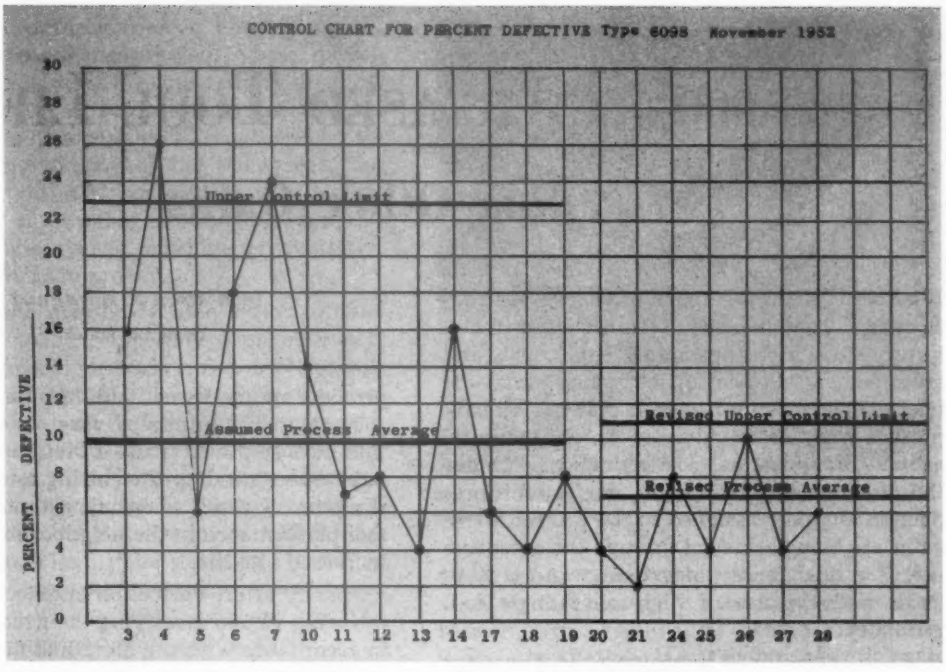
CONTROL CHART FOR PERCENT DEFECTIVE Type 6098 November 1952
PERCENT DEFECTIVE
Upper Control Limit
Assumed Process Average
Revised Upper Control Limit
Revised Process Average
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
3 4 5 6 7 10 11 12 13 14 17 18 19 20 21 24 25 26 27 28

FIGURE 2

Quite a different situation from this classic example exists where the variables are largely of human or operator origin, as in the intricate hand assembly operations common in electronic equipment manufacture. Assuming that materials are delivered to the assembly area in a reasonable state of control and that any tools required are adequate for the job, a high quality product can only result from adequate control of a large number of human variables. Some of these factors are: ability, experience, and training of the worker, his interest in the job, individual and group morale, absenteeism, health and working conditions.

A leading radio tube manufacturer has made a useful and highly profitable application of the control chart for fraction defective to the problem of electron tube assembly. A description of this system and some of its underlying philosophy is presented here in order to stimulate the interest of other companies and expand the use of these valuable tools of product quality control.

Quality Goals

Before starting the program it was necessary to work out carefully the broad objectives. To the extent that these objectives were fulfilled, the success of the program could be measured. These goals were four-fold, namely:

1. To provide a yardstick which would aid the assembly department in a uniform, unbiased appraisal of its own overall quality.

2. To point out specific short term epidemics or departures from quality standards and facilitate their correction.

3. To indicate possible long-term quality trends and provide a basis for analysis.

4. To provide an incentive for better quality workmanship by enabling work groups to participate in their own quality efforts.

The last goal was probably the most important. All too frequently workers are never really informed as to just what is wrong with their work or how they might improve it. Instead, they exist in the ominous void of a "When-will-they-lower-the-boom?" atmosphere. Under the system as installed, every worker could appraise his own performance daily.

Assembly Operation

Components used in radio tube assembly are either manufactured in the various parts departments or purchased from outside vendors. The necessary quantities of all parts are brought to the various positions along the assembly line, where a tube mount is built up by two to seven operators, each of whom performs several hand operations, then passes the mount along to the next operator. Assembly starts with the bottom mica spacer, into which are inserted some combination of cathodes, grids, plates and shields, depending upon the tube type. The top mica spacer is then located, filaments are inserted, the tube base is attached, and the many elements are welded to the proper leads. Special parts such as jump-

. . . *Continued on page 168*

400-900% INCREASED TOOL LIFE

. . . *plus* Other Gains

by Watson N. Nordquist
Technical Editor

PERFECTION STOVE COMPANY—a leading Cleveland manufacturer of cooking, heating, and air conditioning equipment, and an important supplier of jet engine parts — is moving swiftly in a program that has already provided a marked increase in productivity, as well as substantial cost reductions. Under the direction of S. B. Limon, Perfection's production engineer assigned to the project, these gains are being achieved through the extensive use of a new family of grinding and cutting fluids and the use of high-relief angle tool geometry.

When initiating this program, in February of this year, Perfection engineers first used the new Metalloid W O S cutting fluid on production machining only. This move was found to provide an increased tool life ranging from 100% to 200%, estimated very conservatively. The next step was to use a Metalloid grinding fluid when grinding the cutting tools; this had the primary result of ensuring a more uniform tool performance in the neighborhood of 200% increased tool life.

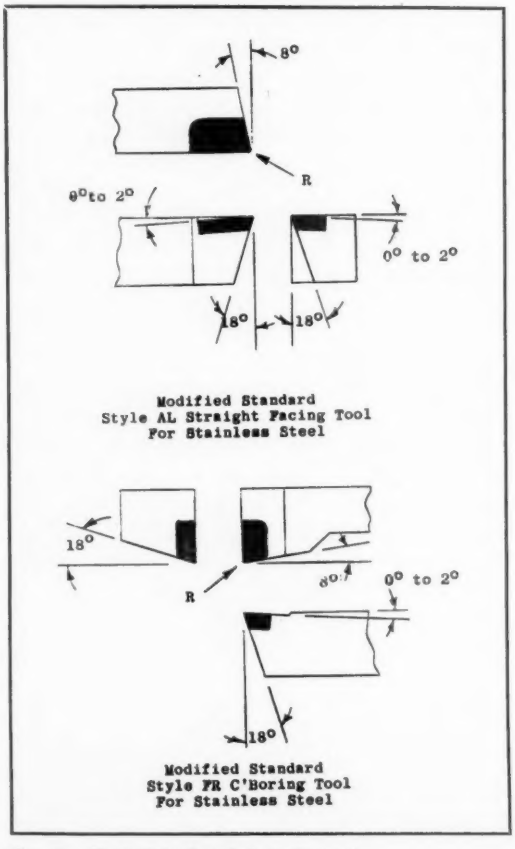

Fig. 1. Typical high relief angle tools.

Shortly after, Perfection engineers took another big step in modifying their tool geometry in accordance with the Metalloid firm's recommendations for seemingly radical high-relief angles (Fig. 1). With 18° relief, tool life ran to 400%-900% over the original figures (BM—before Metalloid). In order to determine just how much of this total gain was due only to the use of the new geometry, they tried the high relief angles in conjunction with the conventional water soluble coolant formerly used. Although the influence of the 18° relief angles alone was notable, results were not comparable to those obtained with the aid of the Metalloid fluid; most important, results were not consistent and some tool breakage was experienced.

Limon concluded that optimum tool life was clearly a function of the combined production use of the Metalloid fluid, high-relief angles, and proper stress-free grinding of the tools.

The first production job where they applied the new cutting fluid was a forged AISI-321 stainless steel flange or ring — about 26″ OD x 22″ ID, and about 5/8″ thickness over half the width. The job was run on a Bullard 36″ Cut Master, with the workpiece held in a 3-jaw fixture. Considerable warpage had been experienced on this part, due to stresses induced in the workpiece during the cutting process. This warpage caused a great deal of trouble, considerable repair work, and about 7% outright scrap. Operations in this setup include facing, boring, c'boring, and de-burring.

Using the new cutting fluid and new tool geometry, Perfection was able to boost the speed from 250-300 sfpm to 590 sfpm (Fig. 2). Tool life is now very good. Work hardening,

warpage and scrap has been entirely eliminated. Whereas it had previously been necessary to take 4 passes, using two settings of the workpiece, to achieve near-satisfactory results — it is now possible to rough and finish with only one setting of the workpiece, removing .060" to .070" per pass on two passes. As a result of lowered set-up time and increased cutting speeds, machine productivity has been greatly improved.

Whereas the previously used water soluble coolant had to be completely changed every 30 days because of rancidity, the first Bullard was charged February 16 with 4 parts water and 1 part Metalloid W O S. Due to some loss from splashing, adherence to workpiece and chip, and water evaporation, occasional replenishing of the charge is necessary; but, a mixture of 10 parts water and 1 part Metalloid W O S is sufficient. The job is still running (August 10) without a complete replacement of the charge having been made, and there is no need for replacement within sight.

Perfection recognizes that while the new cutting fluid is a premium-priced product, its initial price is quickly offset by its life, the increased tool life, production gains, and other results.

The cutting tools run on this original job are all modified standard single-point tools, with brazed-on carbide tips, grade 883. Perfection's experience on widely-differing jobs indicates that the grade of carbide seems to make little difference on the order of savings. On 430 stainless, it was interesting to note that several different grades of carbide gave very much the same results, indicating that the choice of carbide has become less of a critical factor. This did not hold true where high relief angles were not being used.

Perfection Stove is now applying these practices on a nearly plant-wide scale. About 50% of the division's machines are now affected. These include Bullard Cut Masters, vertical turret lathes, and Man-Au-trols, as well as the usual machine tools. Typical operations include drilling, tapping, boring, thread grinding, broaching, face milling, and so on. The materials machined are primarily 321, 430, and 327 stainless and aluminum forgings. In each case, success has been spectacular.

On some jobs, the quality of surface finish had been a problem; on other jobs, machine downtime. The primary objective, therefore, is to correct whatever problem had existed under conventional practice.

In general, optimum tool life has been obtained by increasing the surface speed by

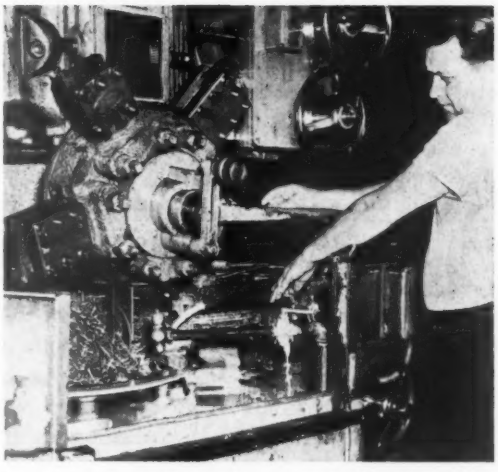

Fig. 2. Facing 321 stainless at 590 sfpm. Tools are changed once a day.

about 3:1 or to the machine's capacity, at the same time reducing the feed to give the same rate of metal removal as before. However, it has been found practical on many jobs to sacrifice some of the tool life gain in order to enjoy a higher rate of metal removal.

On one thread grinding operation, where the work material was AISI-430 stainless, considerable difficulty had been experienced in obtaining a satisfactory surface finish. The previously used thread-cutting agent was replaced with a mixture of 1 part Metalloid and 1 part paraffin oil. Better threads are obtained than ever before, with parts coming from the machine cleaner, and production increased appreciably.

On one difficult form broaching operation, on AISI-430 stainless, the best performance had been a total of 92 pieces per set of broach inserts. During this run, it had been necessary to change one of the finishing inserts three times and another four times. Each insert change requires approximately ½ hour. As a result of using a 1:1 mixture of Metalloid and paraffin oil, all of this intermediate set-up time has now been eliminated, surface finish has been improved, and 115 pieces are run before changing the set of broach inserts.

Again on AISI-430, carbide boring tools — Grade K2S — had been run at 200 sfpm and .008" feed. Three to eight pieces per grind were obtained. Changing to a 1:4 Metalloid W O S and water coolant and high-relief angles, the speed was upped to 450 sfpm and the feed adjusted to .005". With these changes, 30 pieces per grind are now obtained. On a finish grooving operation, K2S tools are now producing 45 pieces per grind as compared to 11-14 pieces per grind previously.

Although Perfection doesn't machine much aluminum on a continuous production scale, they had experienced some trouble on aluminum in holding dimensional tolerances. This condition was apparently due to work-hardening effects of the cutting process. Frequently they would machine a piece to gage, and a couple of days later the piece would be off gage. Use of Metalloid cutting fluid completely eliminated the evidence of work-hardening. A piece will measure tomorrow or a month from now exactly as when taken off the machine today.

Engineer Limon recognizes that the new practices represent no cure-all for their problems. Also, there are jobs now running under conventional practice at maximum machine speeds and where neither downtime nor work finish is a problem. The new practices, however, do offer an entirely new approach to achieving maximum productivity.

In grinding high-relief tools for use with the Metalloid cutting fluid, a pre-mixed grinding fluid — Metalloid X30 and mineral seal — is applied in a mist, using a recently developed unit, the Misticator (Fig. 3). In testing, a carbide blank—grade 78B, 5/16″ x ¾″ x 1″—was ground, with a ¼″ resinoid bond diamond wheel on a K. O. Lee tool grinder. After cleaning both faces of the blank, using kerosene as a coolant, they took a series of passes, removing .001″ at each pass to a total depth of .040″. Upon measuring, they found they had removed .0375″ stock, not .040″. Measurement of the wheel before and after showed a loss of .003″; at that time, they had estimated that each .001″ of wheel diamond was worth $1.89. Then, using the Metalloid fluid with mist applicator, they took another series of passes, removing exactly .040″ of stock. Measurement of the wheel showed a loss of .00075″. This difference in used-up life of the diamond wheel was calculated to represent a substantial saving over a period of time.

Fig. 3. Stress-free grinding of high-relief tools, using fluid vapor and new type diamond wheel.

Perfection is now using a newly-introduced diamond wheel, 100-grit, with electroplated nickel bond. This wheel in one operation does roughing and finishing, providing a better finish than the previously used 60-grit silicon carbide roughing wheel and 180-grit diamond finishing wheel. No attempt has been made to determine how much of this improvement is due to the wheel itself and how much to the new grinding fluid. Performing both roughing and finishing, the wheel outlasts two silicon carbide wheels, 14″ dia., previously used for the roughing. Although exact cost figures were not available, two 14″ silicon carbide wheels normally cost more than the one small diamond wheel of this type, which is understood to run about $100. On top of this saving can be added the cost of the used-up life of the original diamond finishing wheel for a comparable period.

Using the grinding fluid as an invisible vapor permits very accurate tool sharpening while limiting the evolution of heat.

One of the carbide grades that is widely acknowledged as being difficult to grind is the very hard grade K8. Employing conventional practice, five attempts were made to satisfactorily grind a blank of this grade. Each attempt resulted in fracture of the blank. Switching to the new grinding practices, five blanks were quickly ground without any difficulty.

The plant program has now reached the stage where optimum benefits from the new practices demand that carbide cutting tools reach the machine in a completely stress-free condition. As tools wear out, they are replaced by milled and brazed tools that have never been ground by conventional methods. These are ground in the plant's tool grinding room to the required high relief angles, using exclusively the new grinding fluid applied as a mist and the new fast-cutting, 100-grit diamond wheel. The only exception to this is where substantial stock must be removed from the cutting tool, for which a soft-bond silicon carbide wheel is used in roughing.

Plant-wide cost reductions and increased productivity have been the result.

The Development of a

GAGE CONTROL SYSTEM

by C. H. Borneman
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QUALITY CONTROL usually requires measurement of the product. Mechanical measurements usually require gages. It is not economical to make gages perfect nor to keep them perfect. Gages must, therefore, be controlled as to their own quality.

A gage control system is necessary to assure the accuracy of gages that are in use in the shop; or gages that are in the tool crib or gage crib ready for reuse; or gages that are in reserve stock. A gage control system must also assure the accuracy of the master gages that are used to check other gages.

The following conditions can cause gage sizes to change:

1. Wear of the surfaces that contact the work.
2. Change of adjustment of adjustable gages.
3. Springing of gage frames beyond their elastic limit.

If proper heat treatment and aging practice has not been used, gages can also change size because of molecular change of the gage material — usually in the direction of growth.

A gage control system should include the whole procedure of requesting, ordering and inspecting new gages; reinspecting gages periodically during their useful life; scheduling the reinspection dates; systematizing the return of gages for inspection; arranging for the repair of salvable gages; recording gages according to kind and size of gage or kind of product being inspected; recording the location of gages both when not in use and when in use; and recording the final disposition of the gages when they are not economically salvable, or when they are obsolete, or when the piece parts which they measured are no longer being made.

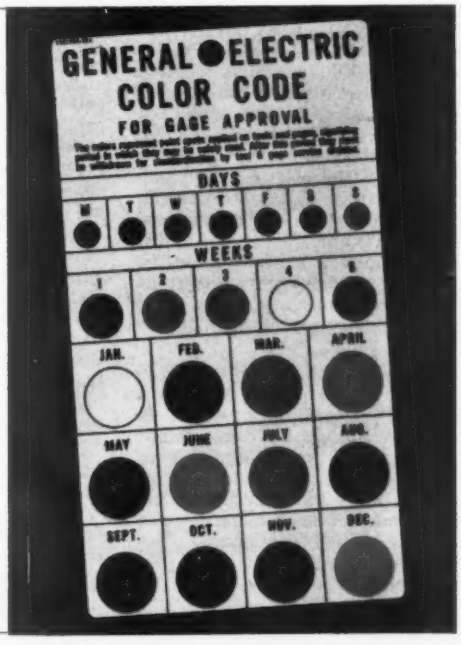
Three gage control procedures in common use provide for:

1. The required return of gages at the end of each job or shift, or other fixed period of time.
2. Gage reinspection at the point of use.
3. The date marking of gages indicating the limit of time beyond which each kind of gage

. . . *Continued on page 70*

COLOR CODING

	Dykem Ref.
January—White	DW
February—Purple	DKG
March—Yellow	DLT
April—Light Green	DXX294
May—Red	DNC
June—Light Blue	DMF
July—Pink	DXX300
August—Dark Green	DRJ
September—Dark Blue	DSL
October—Orange	DNX
November—Brown	DTM
December—Gray	DT
First Week	Brown
Second Week	Gray
Third Week	Yellow
Fourth Week	White
Fifth Week	Black (DB)
Monday	Purple
Tuesday	Dark Blue
Wednesday	Pink
Thursday	Red
Friday	Orange
Saturday	Green

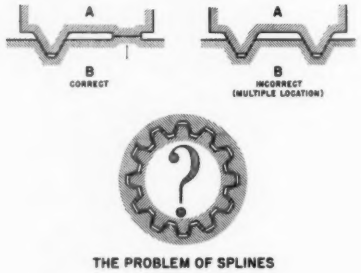


QUALITY CONTROL OF INVOLUTE SPLINES . . . made easy by proper design and inspection

by Albert S. Beam
Gear and Standards Engineer
and
Leon N. DeVos,
Field Engineer
VINCO CORPORATION
Detroit, Mich.

SPLINES are machine elements consisting of integral keys (teeth) or keyways (tooth spaces) arranged in a circle. In the past decade the involute spline has met increasing acceptance and has become the preferred solution for most design applications.

Splines are designed to provide location on a multitude of matching tooth surfaces. This basic requirement represents a rather flagrant violation of an elementary rule of machine design which requires that multiple locating surfaces be avoided. Figure 1 illustrates this rule. In the upper left-hand view,



THE PROBLEM OF SPLINES

FIGURE 1

the slide "A" is located on bed "B" by a v-groove and a pad. The v-groove provides horizontal location and support for part of the weight; the raised pad carries the remaining weight. Two v-grooves, as shown in the right-hand view, create a problem of fitting due to slight differences in the width, the spacing and the parallelism of the v-members in "A" and "B". The third view of Figure 1 shows the spline as a rank offender with as many as 8, 12, 16, and sometimes many more teeth acting or expected to act as locators.

To meet the problem of multiple location, it was necessary to adopt a system of dimensioning which is peculiar to splines. No consistent solution seemed to be available to the problem of dimensional control of splines until the concept of "effective" and "actual" dimensions was presented, which is further explained in the following paragraphs. This concept was first proposed by Vinco in their 1945* catalog; it was accepted on a national scope through the 1950 revision of the American Standard B5.15 for Involute Splines.

It must be recognized that the fit between mating splines is not sufficiently defined by just the space width of the internal spline and the tooth thickness of the external spline; the fit is also affected by errors in spacing, profile, out of roundness and lead. Figure 2A shows an internal spline with pitch and profile errors; out of roundness and lead errors are not illustrated. Figure 2B shows that an ideal spline contour, without errors, does not fit the internal spline even though each tooth has the same width as the corresponding mating space. To allow the ideal spline contour to fit in any position, its teeth must be narrowed by the amount of interference shown in Figure 2B. The **effective space width** of the internal spline is equal to this narrower width as shown in Figure 2C.

The same reasoning applied to the external spline leads to the concept of **effective tooth thickness** of an external spline as a dimension equal to the circular space width, on the pitch circle, of a theoretically perfect internal spline which would fit the external spline without freedom or interference.

Effective space width or tooth thickness define a contour which can be controlled only by means of an accurate mating member in the form of a spline gage with a full complement of teeth, namely a **composite spline gage.** The effective space width of the internal spline minus the effective tooth thickness of the external spline is the **effective clearance** which establishes the fit between mating parts.

The width of single spaces, which is greater than the effective space width, is termed the **actual space width** of the internal spline. The **actual tooth thickness** of the external spline is the circular thickness on the pitch circle of single teeth. Actual space width and actual tooth thickness are checked by means of pin measurements or by gages which contact diametrically opposite single spaces or teeth.

The difference between effective and actual dimensions represents the accumulated effect of the spline errors and is termed the **effective error,** and the amount of permissible effective error is the **error allowance.**

A clear understanding of the distinction between "effective" and "actual" dimensions permits the construction of part specifications which

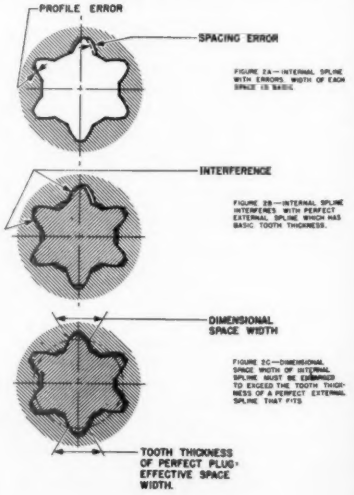


FIGURE 2

(This article contains excerpts from papers presented to the Detroit Chapter of the A.S.T.E. in June 1953.)

*See also "Effect of Interference Errors on Tooth Thickness of Splines" by A. S. Beam, S.A.E. Journal, Transactions, Volume 54, No. 6, June 1946.

are consistent with service requirements and provide a clear path for the processing and inspection of splined components.

Table 1 is presented as a key to space width and tooth thickness specifications. It incorporates, at the left, a bar chart which illustrates the relation of effective and actual space width and tooth thickness dimensions of a set of mating splines which are designed for a sliding fit. The actual space width and actual tooth thickness are permitted to vary within given machining tolerances. Effective dimensions have a corresponding range of variation; consequently there are four limit dimensions for each part. The construction of all limit dimensions follows a simple procedure:

The minimum effective space width is always basic, equal to half the circular pitch. This assumption requires acceptance of the spline hole by a basic "Go" composite plug gage. The maximum effective tooth thickness is established by the desired minimum effective clearance or backlash. To arrive at the maximum effective space width and the minimum effective tooth thickness, the total permissible fit variation is distributed between the internal and external splines according to manufacturing requirements. Limit dimensions for the actual space width are constructed by adding a suitable error allowance to the effective space width; similarly maximum and minimum actual tooth thickness are constructed by subtracting a suitable error allowance from the effective tooth thickness dimensions. Error allowances are selected on the basis of the design requirements and the accuracy of manufacturing methods which is known from experience.

Minimum and maximum effective clearance or backlash, which represent the fit limits, are shown in the bar chart as the differences between the effective dimensions of the internal and external splines. The spread between actual space width and actual tooth thickness is the **nominal clearance.** This does not define the fit because it does not allow for the effect of spline errors.

The introduction of effective and actual dimensions gives the designer not only a discriminating means of expression, but also the responsibility for the proper selection of specifications. A complete set of all limit dimensions, shown in the bar chart, is rarely required. The combination of dimensions, which is specified to control the product, constitutes the **control system.** Table 1 shows three control systems. Systems C101 and C102 are used for splines requiring service life under load, C103 for instrument splines which transmit

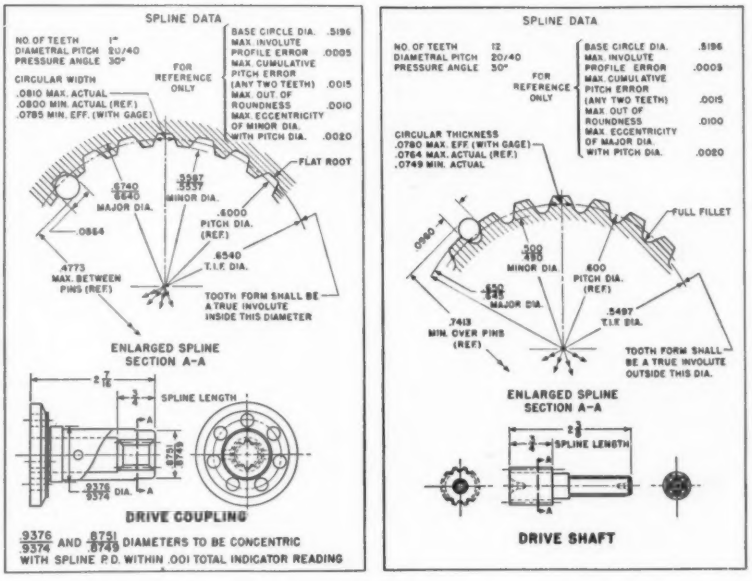

SPLINE DATA
NO. OF TEETH 11
DIAMETRAL PITCH 20/40
PRESSURE ANGLE 30°
FOR REFERENCE ONLY
BASE CIRCLE DIA. .5196
MAX. INVOLUTE PROFILE ERROR .0005
MAX. CUMULATIVE PITCH ERROR (ANY TWO TEETH) .0015
MAX. OUT OF ROUNDNESS .0010
MAX. ECCENTRICITY OF MINOR DIA. WITH PITCH DIA. .0020
CIRCULAR WIDTH .0810 MAX. ACTUAL .0800 MIN. ACTUAL (REF.) .0785 MIN. EFF. (WITH GAGE)
FLAT ROOT
MAJOR DIA.
MINOR DIA.
PITCH DIA. (REF.)
T.I.F. DIA.
MAX. BETWEEN PINS (REF.)
TOOTH FORM SHALL BE A TRUE INVOLUTE INSIDE THIS DIAMETER
ENLARGED SPLINE SECTION A-A
SPLINE LENGTH
DRIVE COUPLING
AND DIAMETERS TO BE CONCENTRIC WITH SPLINE P.D. WITHIN .001 TOTAL INDICATOR READING
SPLINE DATA
NO. OF TEETH 12
DIAMETRAL PITCH 20/40
PRESSURE ANGLE 30°
FOR REFERENCE ONLY
BASE CIRCLE DIA. .5196
MAX. INVOLUTE PROFILE ERROR .0005
MAX. CUMULATIVE PITCH ERROR (ANY TWO TEETH) .0015
MAX. OUT OF ROUNDNESS .0100
MAX. ECCENTRICITY OF MAJOR DIA. WITH PITCH DIA. .0080
CIRCULAR THICKNESS .0780 MAX. EFF. (WITH GAGE) .0764 MAX. ACTUAL (REF.) .0749 MIN. ACTUAL
FULL FILLET
MINOR DIA.
PITCH DIA. (REF.)
MAJOR DIA.
T.I.F. DIA.
.7413 MIN. OVER PINS (REF.)
TOOTH FORM SHALL BE A TRUE INVOLUTE OUTSIDE THIS DIA.
ENLARGED SPLINE SECTION A-A
SPLINE LENGTH
DRIVE SHAFT

FIGURE 3

motion only, rather than power, and for press fits. The letter "R" stands for required specifications. The letter "O" designates optional reference data.

It will be noted that the minimum actual space width and the maximum actual tooth thickness are optional reference dimensions in all control systems. These two dimensions do not establish acceptance or rejection of parts. If, for instance, the actual space width of the product is less than the minimum, without causing the effective space width to be undersize, or if the actual tooth thickness is more than the maximum without causing the effective tooth thickness to be oversize, then the effective errors would be less than the assumed error allowance; in this case, the quality of the spline is better than anticipated because the full error allowance is not needed. As long as the minimum backlash is maintained, undersize actual space width or oversize actual tooth thickness are not only permissible, but desirable. However, the specification of these two dimensions may be desired for processing reference and is, therefore, optional. They permit the machine operator to judge, from pin measurements or indicator gage readings, whether or not machining variations are within anticipated limits. These reference dimensions are also used to determine the cause of undersize effective space width or oversize effective tooth thickness which may be due to either the actual dimension not being within limits or to excessive manufacturing errors.

Control System C101, which is applicable for the majority of splines, requires specification of the extreme effective and actual dimensions, for instance the maximum effective tooth thickness and the minimum actual tooth thickness. This system controls the maximum spread which is the sum of the machining tolerance and the error allowance. It permits either of these factors to increase at the expense of the other. Increased machining tolerance with reduced spline errors is permitted because it is advantageous, as discussed before. Increase of spline errors would require closer control of actual space width or tooth thickness and would eventually be discovered through an increase in the scrap rate. This system would permit machining to the extreme actual size with a very minimum of spline errors, in which case the maximum effective clearance would approach the maximum nominal clearance and backlash would be excessive. Since the extent to which spline errors can be reduced is limited by the very

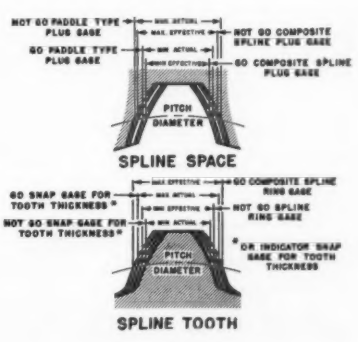
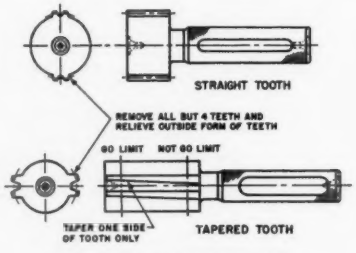

NOT GO PADDLE TYPE PLUG GAGE
NOT GO COMPOSITE SPLINE PLUG GAGE
GO PADDLE TYPE PLUG GAGE
GO COMPOSITE SPLINE PLUG GAGE
PITCH DIAMETER
SPLINE SPACE
GO SNAP GAGE FOR TOOTH THICKNESS *
NOT GO SNAP GAGE FOR TOOTH THICKNESS *
GO COMPOSITE SPLINE RING GAGE
NOT GO SPLINE RING GAGE
* OR INDICATOR SNAP GAGE FOR TOOTH THICKNESS
PITCH DIAMETER
SPLINE TOOTH

FIGURE 4

nature of manufacturing processes, the backlash increase never extends to the maximum nominal clearance. In most cases the probable extent of the backlash increase will not be great enough to require additional controls. However, when backlash must be held under all circumstances within the predetermined limits, it is possible to add the specification


STRAIGHT TOOTH
REMOVE ALL BUT 4 TEETH AND RELIEVE OUTSIDE FORM OF TEETH
GO LIMIT
NOT GO LIMIT
TAPER ONE SIDE OF TOOTH ONLY
TAPERED TOOTH

INVOLUTE SPLINE PADDLE TYPE PLUG GAGES

FIGURE 5

of maximum effective space width and minimum effective tooth thickness, as shown under **Control System C102.** The addition of this specification requires additional inspection equipment and more inspection time.

Control System C103 is designed for splines which require inspection of minimum and maximum looseness only, without regard to the width of single spaces and single teeth. In this system, only the effective dimensions are control limits for final inspection and spline errors are permitted to cause variations of actual sizes without control. This system is applicable when the amount of contact area between mating splines is of secondary or no importance or, in the case of press fits, when localized interference is sufficient to meet operating requirements. This system is also used when control of spline errors is assured through laboratory inspection.

The selection of a suitable control system solves the problem of space width and tooth thickness specifications. In addition to the tooth thickness and space width, all other spline elements should be clearly defined as shown in Figure 3, which illustrates a completely dimensioned set of splined components. The selected example refers to a sliding fit and employs Control System C101. Most designers are familiar with the specification of major and minor diameters and limits for these dimensions. It should be pointed out that close limits are not required for these diameters if the fit occurs at the sides of the teeth and clearance exists at the major and minor diameters.

The specification of a true involute form (TIF) diameter should not be omitted since it establishes the depth of required tooth profile without forcing the process engineer and gage designer to make reference to the mating part. Usually, this dimension goes slightly beyond the depth of engagement with the mating part. The extension of true form depth is called the **true form clearance** and allows for the looseness between mating splines and for possible major and minor diameter eccentricities.

Attention should be paid to placing the note "for reference only" at those dimensions which, in the designer's judgment, do not require individual inspection. In the case of Control System C101, where the sum of the effective error and the machining tolerance is held within the spread of the maximum actual and minimum effective space width or maximum effective and minimum actual tooth thickness, all spline errors are marked as reference data. This will prevent the loss of time entailed in detailed laboratory inspection of all tooth elements. If paddle gages or snap gages are intended to be used for the inspection of maximum actual space width and minimum actual tooth thickness, the pin measurement is marked "reference" because it will be needed only as long as gages are not available.

The design of splines is immeasurably aided by the use of available standards, such as the **American Standard B5.15-1950 for Involute Splines,** and the **American Standard B5.26-1950 for Involute Serrations.** The American Standard B5.15 recommends two types of fit, **the side fit,** and the **major diameter fit.** The major diameter fit is gaining increased acceptance because the surface at the major diameter is usually smoother than at the sides of the teeth and because the major diameter can be controlled easily on external parts and broached internal parts.

The American Standard for Involute Splines also offers useful guidance when special conditions preclude the strict application of standard dimensions. From past experience, we are quite confident that standard splines can be adapted to meet almost any design and service condition. It is urged, therefore, that serious consideration be given to the use of standard involute splines and serrations in order to permit the widest application of standard tooling and to provide a greater uniformity in the methods of spline specification.

The inspection of splines and the design of spline gages is covered in two additional standards:

The **American Standard for Involute Spline and Serration Gages and Gaging B5.31-1953,** published by the A.S.M.E., provides a useful comprehensive source of information upon which to base any type of spline inspection program.

The **Commercial Standard CS8-51,** published by the U. S. Department of Commerce in cooperation with the National Bureau of Standards, incorporates the standard blanks for involute spline gages.

To avoid confusion and misunderstanding, which cause much expense and delay, product designers, tool engineers, quality control engineers, gage designers and inspectors should understand what variables affect splined connections and how they can be controlled. It must be emphasized that correct tool design, gage design and spline fit control are wholly dependent upon proper part print specifications.

Illustrated in Figure 4 are the important dimensional factors of an internal spline and an external spline. The gages used to control these factors are also listed.

The following paragraphs are intended to illustrate and describe those types of gages which are most generally used. The American Standard for Involute Splines and Serration Gages and Gaging covers all important types of gages.

Figure 5 shows a paddle type plug gage used to control the actual space width of an internal spline. It performs an inspection similar to a check between pins. The Not Go paddle gage checks the maximum actual space width, the Go paddle gage checks the minimum actual space width. The outer sides of the teeth, on this type of gage, are relieved so that only the two most diametrically opposite spaces are in contact with the splined part. This permits the entrance of the gage regardless of accumulated interference errors.

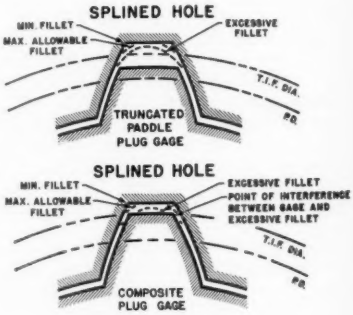
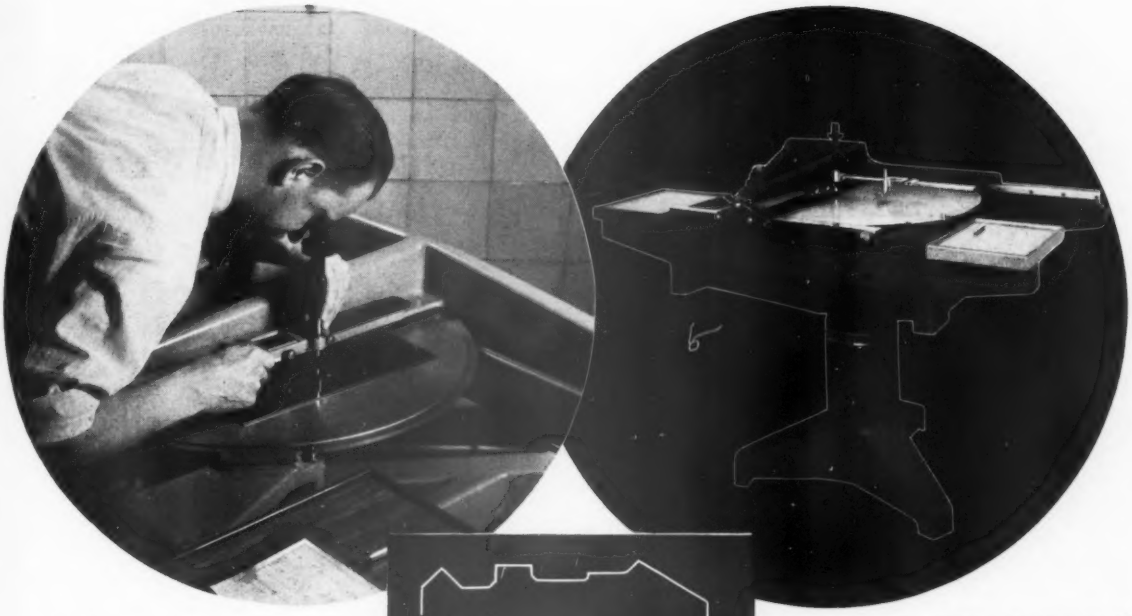


FIGURE 6

The tapered tooth paddle plug gage is a combination Go and Not Go gage with scribed lines to show the control points. It is used on parts with close tolerances or where close size control is desired, so that parts can be selected within a given size

. . . *Continued on page 72*

"Bright line" drawings, made on the CINCINNATI Layout Scribing Machine, are 20 times size; permit passage of light through the lines.



CINCINNATI Layout Scribing Machine. The drawings, made on this equipment, termed "bright line" drawings, are used in the setup on CINCINNATI Projecto-Form Grinding Machines. Ask for catalog No. M-1612-3.

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. . . Statistical Q. C., from page 57

Sum over D

	4	5	6	Total
7	995	997	981	2973
8	1016	982	960	2958
9	1004	961	885	2850
Total	3015	2940	2826	8781

Sum over E

	1	2	3	Total
7	952	1039	983	2973
8	989	963	1006	2958
9	853	982	1015	2850
Total	2794	2983	3004	8781

Sum over F

	4	5	6	Total
1	986	924	884	2794
2	1020	1014	949	2983
3	1009	1002	993	3004
Total	3015	2940	2826	8781

(1) 953259.7
9)8579337

(2) 952,239
27)25710993

(3) 952,596.3
27)25720101

954,413.4
9)8589721

952,239

952,916.3
27)25728741

953,862.1
9)8584759

952,916.3

952,596.3

(4)
81)77105961(951,925.4

(5)
3)2868081(956,027

(6) 965,797

SUMMARY OF VARIANCE

Source	Σ Squares	df	Mean Squares	F Ratio
D	9,909	2	4,954	3.12 *(2/73)
E	6,336	2	3,168	2.00 (2/73) 17%
F	6,709	2	3,354	2.11 (2/73) 16%
DE	11,636	4	2,909	1.58 (4/53) not significant
DF	2,749	4	687	not significant
EF	3,298	4	824	not significant
DEF	380	8	48	not significant
Residual	97,700	53	1,843 (1586)	
Total	138,716	79		

Fig. 6. Analysis of Experiment II.

tables that have to be formed and the three calculations that are made from each of the two-way tables. The first column is that obtained from summing the squares of the individual values in each of the three tables. The second column gives the results of operating upon the squares of the row totals. And the third column shows the results of summing the squares of the column totals. Item four is obtained from the squaring of the grand total; item five from the squaring of the totals given in Figure 5; and item six from the squaring of the original individual values given in Figure 5.

These quantities are then combined according to statistical practice in variance analysis to make up the Summary of Variance Table given at the bottom of Figure 6. There we estimate the mean squares for each of the three factors, D, E and F, for the first order interactions DE, DF and EF, the second order interaction DEF, and the residual or error term. The number of degrees of freedom for each main effect is one fewer than the number of levels of that main effect; and the product of the main effect degrees of freedom that are involved in each interaction gives us the degrees of freedom for that interaction.

The total number of degrees of freedom for the entire experiment will be one fewer than the total number of pieces of data. In this instance, however, we had to insert one value out of the eighty-one arbitrarily, due to the fact that it was lost during the experiment. This cost us another degree of freedom so that our total degrees of freedom are 79, rather than 80. Subtracting the degrees of freedom that we have already mentioned from the total gives us the residual or error degrees of freedom, 53.

We then obtained the mean squares and the F ratio for each effect by dividing its mean square by that of the residual. Where a mean square for any effect is smaller than that of the residual, it is not necessary to perform this operation because it will not be significant. When we tested interaction DE, with an F ratio of 1.58, we found it not significant, even at the 20% level. Therefore it was possible to combine the sums of squares for all the interactions with that of the residual to make

. . . Continued on page 184

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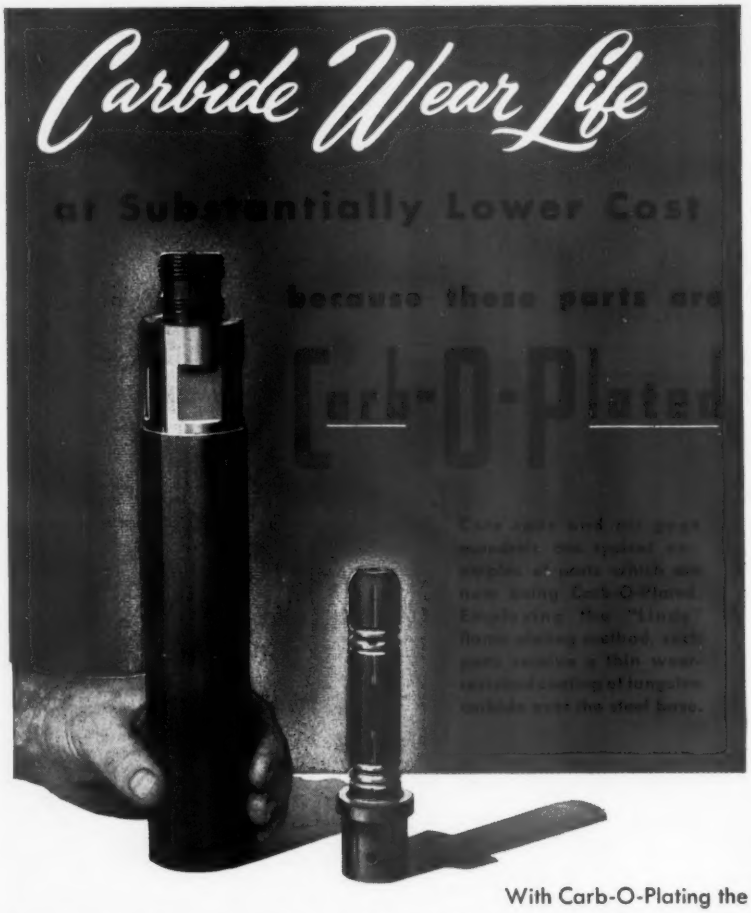

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. . . Gage Control, from page 63

should not be used until its accuracy has been determined by reinspection.

For intermittently used gages a relatively safe procedure is to require that the gages be turned in at the end of the job, or at the end of the shift or day or week, and that the gages be reinspected before reissue for use.

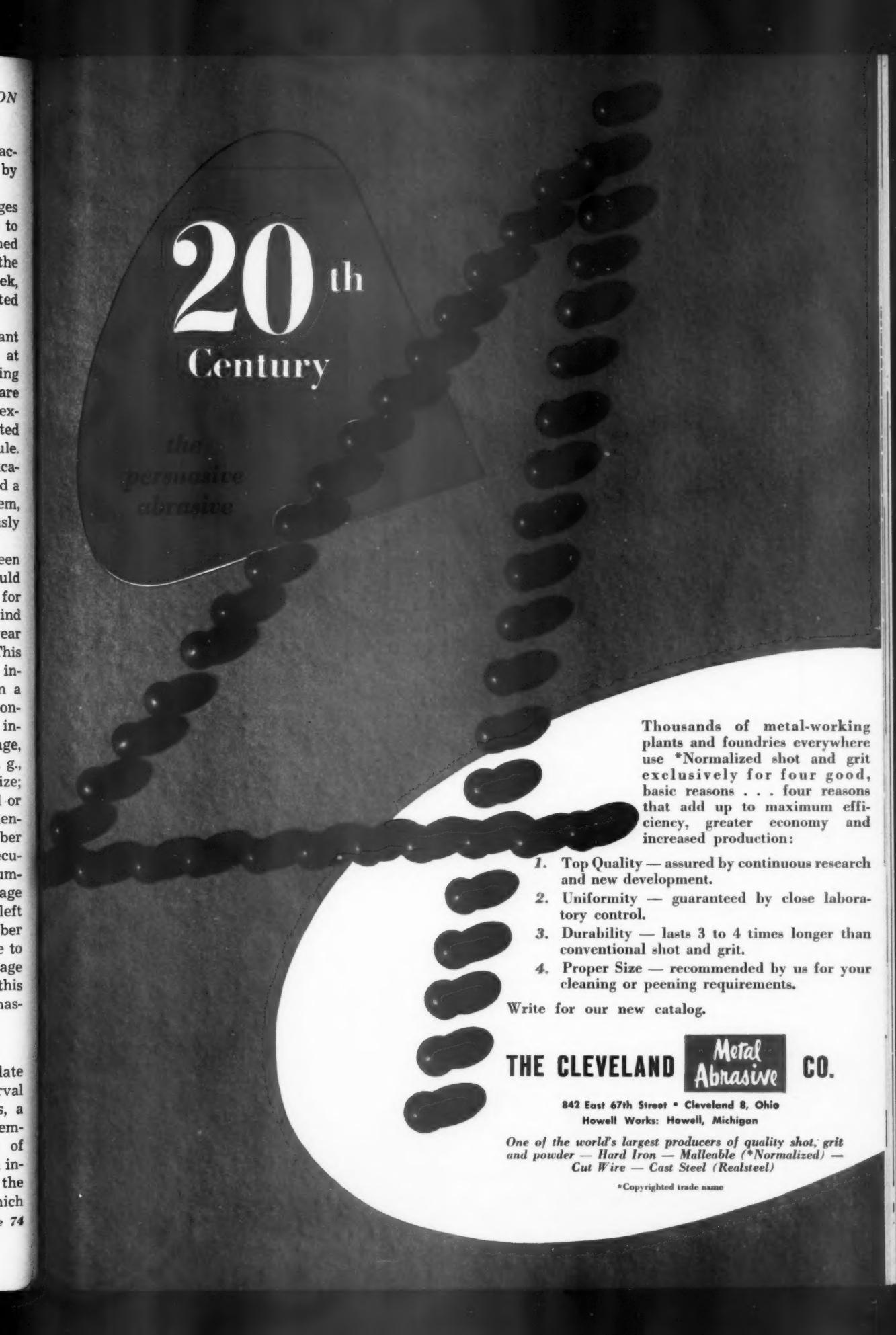
Gages which are in constant use are sometimes inspected at the point of use by a traveling gage inspector, or they are picked up on the job and exchanged for newly-inspected gages on a regular schedule. This system requires identification numbers on the gages and a careful card record system, which must be conscientiously followed.

The interval of time between reinspections for a gage should be based on experience for each type of gage and the kind of material of which the wear surfaces are composed. This interval of time between inspections should be noted on a master card on which is contained all the other pertinent information relating to the gage, including the kind of gage, e. g., plug or ring or snap; the size; whether the gage is standard or special as to design; and an identifying number. This number may be one of a single consecutive series of numbers; or a number designating the kind of gage and size in the digits to the left of a dash and the serial number for that kind and size of gage to the right of the dash. If the gage is for a special product, this should also be noted on the master card.

Color Coding

Besides the prescheduled date for reinspection or the interval of time between inspections, a further safeguard may be employed to prevent the use of gages beyond their inspection interval limit. This can take the form of a color code in which

. . . *Continued on page 74*



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. . . Splines, from page 66

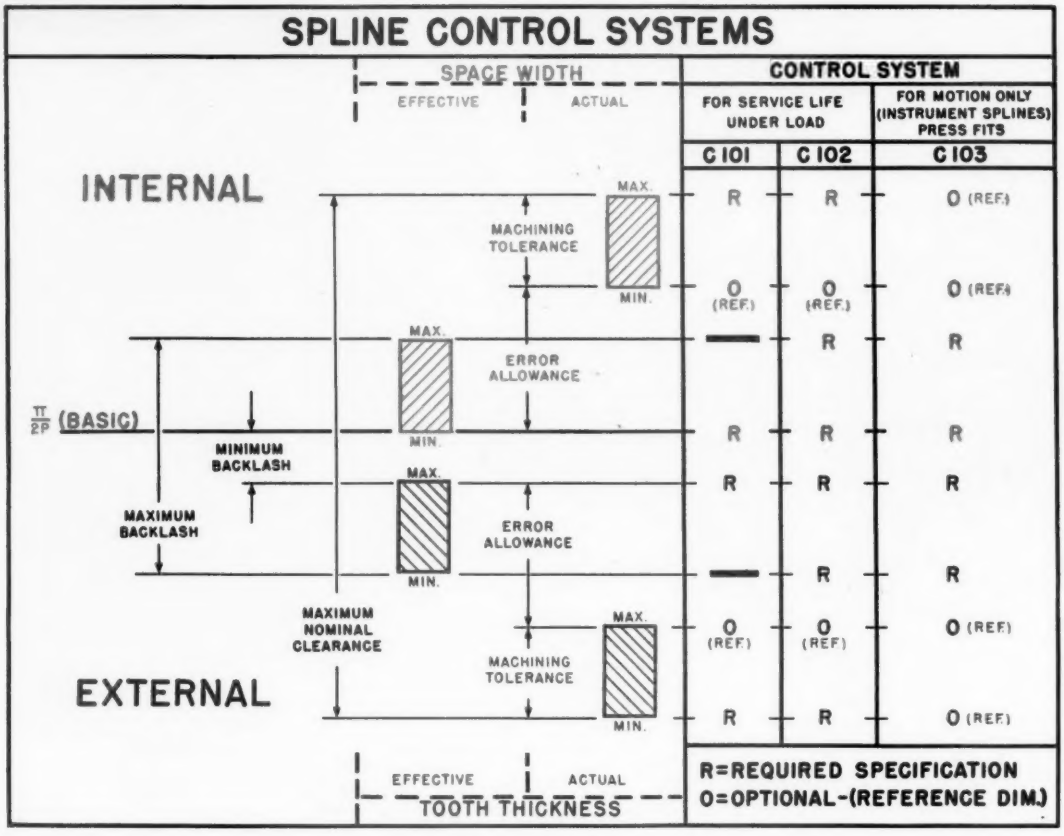


TABLE I

range. Since the tapered tooth plug gage measures the actual space width of the splined part, rather than merely establishing its acceptability, it is often preferred over Go and Not Go paddle plug gages.

Paddle type plug gages are truncated (major diameter reduced), see Figure 6, so that they are not affected by excessive fillets. Excessive fillets can be caused by worn or improperly designed tools. Should these fillets extend beyond allowable limits, the Go composite plug gage, which is not truncated, will not enter the work.

The Go paddle plug gage is used only to evaluate rejection by the Go composite plug gage or to aid in setting up production equipment. If the Go paddle plug gage enters the work and the Go composite plug gage rejects the part, it is an indication of excessive interference errors or an excessive fillet.

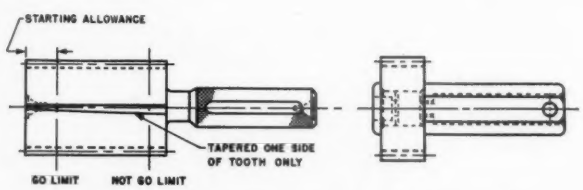
Composite spline plug gages, shown in Figure 7, control the effective dimensions. The Go composite spline plug gage checks the minimum effective space width and serves as an acceptance gage only. It reveals interference but does not disclose which dimension or relationship is incorrect.

A Not Go composite plug gage controls the maximum effective space width; it does not control the width of individual spaces. It will not enter, and thus accept the part even though all spaces are oversize if their relative position prevents the Not Go composite gage from entering. The Not Go composite plug gage is used only when the maximum effective space width is specified and not marked "reference." (See Control Systems C102 and C103).

The tapered tooth composite plug gage is a combination Go and Not Go gage with scribed lines to show the control points. It is used on parts with close tolerance and, if desired, permits selection of parts within a given size range. Since the tapered tooth gage measures the effective space width of the splined part, rather than merely establishing its acceptability, it is often preferred over separate Go and Not Go gages.

For the splined shaft, the roller

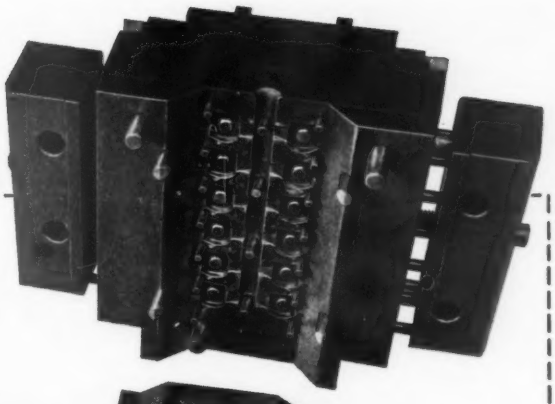
. . . Continued on page 89

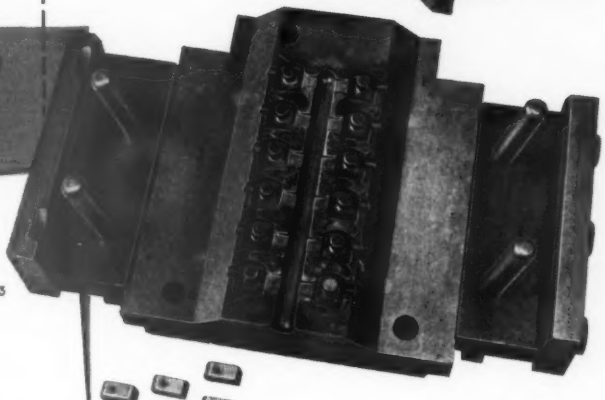


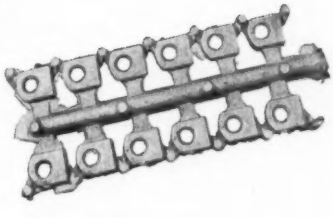
COMPOSITE PLUG GAGES

FIGURE 7

"AFTER PRODUCING 50 MILLION PIECES, THIS DIE STILL SHOWS NO WEAR."







Die-Casting Die Made of Hoyland "HSC 33" Hot Work Tool Steel

Illustrated is die made by Springfield Die Casting Co. of Kenilworth, N. J. for precision casting of a lamp nut blank made for the NYLOK Corporation of Elmira Heights, N. Y. and used in sealed beam headlights.

What The Springfield Die Casting Company Says About Hoyland "HSC 33" Hot Work Tool Steel

SPRINGFIELD DIE CASTING CO.
739 FAIRFIELD AVENUE - KENILWORTH, NEW JERSEY
CHESTNUT 5-0809

August 6, 1953

Hoyland Steel Company, Inc.
5104 Chrysler Building
New York, New York

Attention: Mr. W. Hughes White

Gentlemen:

This is in reply to your request for information about our experience with a casting die of Hoyland Steel Company's "HSC 33" Hot Work Tool Steel.

We are pleased to advise you that this die was used continuously from 1948 to 1951 and intermittently since then to produce a zinc lamp nut blank for the sealed beam headlight used by one of the top automobile manufacturers. We are particularly pleased to point out that after producing 4 million shots on a 12 cavity die, this die of your #33 steel shows no appreciable wear. It is in perfect operating condition and still functions within the original tolerance of 0.002 inch. Both ourselves and our customers have been pleased with the performance of this die. We hope this provides you with the information you require. Please call upon us for any additional information you may need.

Sincerely,

SPRINGFIELD DIE CASTING CO.

Albert F. Bucher

Albert F. Bucher, President

About "HSC 33" Hot Work Tool Steel

The inclusion of chromium, tungsten, molybdenum and silicon provide "HSC 33" with the qualities of red-hardness, toughness and resistance to disturbances caused by water cooling. Its resistance to heat checking makes it valuable for piercing, forging, die casting and other purposes. "HSC 33" hardens in air with a minimum of distortion and can withstand alternate heating and cooling. Among its many other uses are: die inserts, forming dies (hot), gripper dies, die casting dies, mandrels (hot), piercers (hot), plungers (hot), shear blades (hot) and punches (hot).

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ROCKET

RED ARROW

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. . . Gage Control, from page 70

two or three colored spots are put on the gage. The largest spot denotes the month; the second spot denotes the week; and, where necessary, a third spot denotes the day of the week beyond which the gage should not be used. Manufacturing and inspection personnel must be informed of the meaning of the color spots, and they must have ready access to reference charts showing the respective color for each month, week of the month, and day of the week. As the color spots on a gage that is being used beyond its limit date will be of different colors than the color spots on the gages that are in legitimate current use, the void gage is readily noticed.

This color code, which is used in a number of General Electric Company plants, has the added benefit of giving assurance of gage accuracy to customers' inspectors who visit or work in the plant because they can readily detect any gage which is being used beyond the date on which it should have been reinspected.

Colors may be applied with a brush fitted into the cap of the paint bottle, or by the fountain pen type of applicator which uses a felt brush in the end of a fountain pen shaped paint container. When the marking must be put on the surfaces of gages which would be subject to handling, a shallow counterbore for each color spot is put into the gage at the time the gage is manufactured.

The paint used in our General Electric Company plants is a paint which is not readily removable by anything except acetone. Sets of bottles or fountain pen markers are assembled into kits. Care must be exercised to be sure that the colors do not change due to settling out of some of the pigments. In filling the bottles, it is necessary that the paint be thoroughly stirred before such filling; and, at the time of use, the bottle or

. . . Continued on page 76

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"Three vital advantages built into Delta Drill Presses explain why we use 200 of them," says Charles Curtis, Production V. P. of Copeland Refrigeration Corp., Sidney, Ohio . . .

"1. **PRECISION**—a must. We fight 'tenths' in this business; normally, .002" undersize is scrapped.

"2. **VERSATILITY**—you can mount Delta drill presses upside-down, sideways, gang them in numerous ways.

"3. **LOW INVESTMENT**—numerous permanent set-ups ready for all operations are vastly cheaper than a few that involve set-up time, labor and scrap cost resulting from constant changes of set-ups. We make a variety of plates, heads and parts, and can make a run on one piece simply by taking jigs and fixtures off the shelf.

Direct labor saving of $24,000 a year on one operation

"As for special tools, here's one that out-performs a $16,000 radial drill press. We cut a Delta drill press pedestal in two, put an extension between, mounted the unit on an idle heavy base, fastened a swivel on each half-pedestal, mounting the drill head—and obtained a knee action that does all the radial drill did, only much better. The special Delta rig costing not over $300, operates at 2400 RPM as against 400 RPM; drills more than 200 pieces per day, as against 30-35 pieces; uses 3 men (always ahead of schedule) as against 7 men (always behind)—for a two-shift direct labor saving of $24,000 a year.

"No wonder we like Deltas."

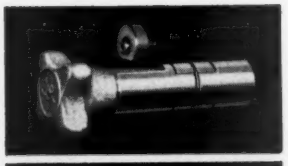
Nothing here that a bit of ingenuity and common sense can't duplicate! —with cash benefits that can easily run big. Ask your Delta dealer for the latest Delta Catalog—listed in your Classified Directory under "Tools," —or write direct to Delta Power Tool Division, Rockwell Manufacturing Company, 622K N. Lexington Ave., Pittsburgh 8, Pa.

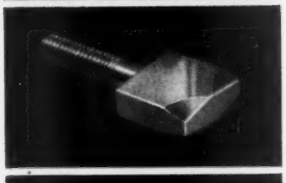
DELTA QUALITY POWER TOOLS

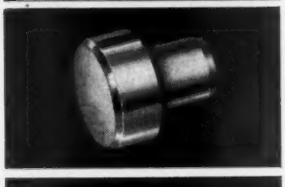
Another Product by **Rockwell**

SEE ADVERTISERS INDEX, BACK OF BOOK, FOR INFORM-A-GRAM KEY NUMBERS

SAVE UP TO 70% on Designing and Machining





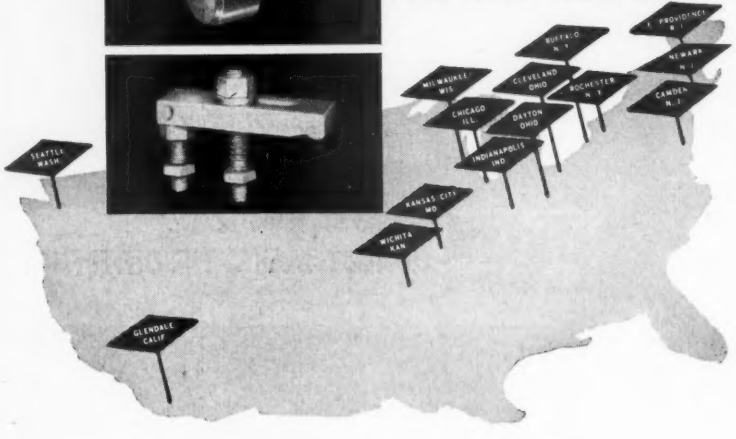


WESPO

Standard Clamps and Components

AVAILABLE IN STOCK

all over the U. S.



15 Clamp Styles in 119 Sizes
Over 600 Component Parts

There is a WESPO clamp assembly to suit every job—15 types, 119 sizes. WESPO clamps are carefully designed to meet the needs of Fixture Designers—Tool Makers—Machinists.

WESPO parts are precision manufactured of quality steel—heat treated and rust proofed. They are designed for heavy duty and long wear and have proved their value in many industries.

IMMEDIATE DELIVERY FROM STOCKS AT FACTORY AND FOLLOWING

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Roessel & Co., 683 Hudson Ave.—ROCHESTER 21, N. Y.
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Hub City Factory & Mill Supply Co., 2013 James St.—SYRACUSE 6, N. Y.
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Cummings & Co., 115 E. Lewis St.—WICHITA 2, KANSAS

WEST POINT MFG. CO.
26935 W. 7 Mile Road, Detroit 19, Mich.

. . . Gage Control, from page 74

fountain pen should be shaken to stir up the pigments in the paint.

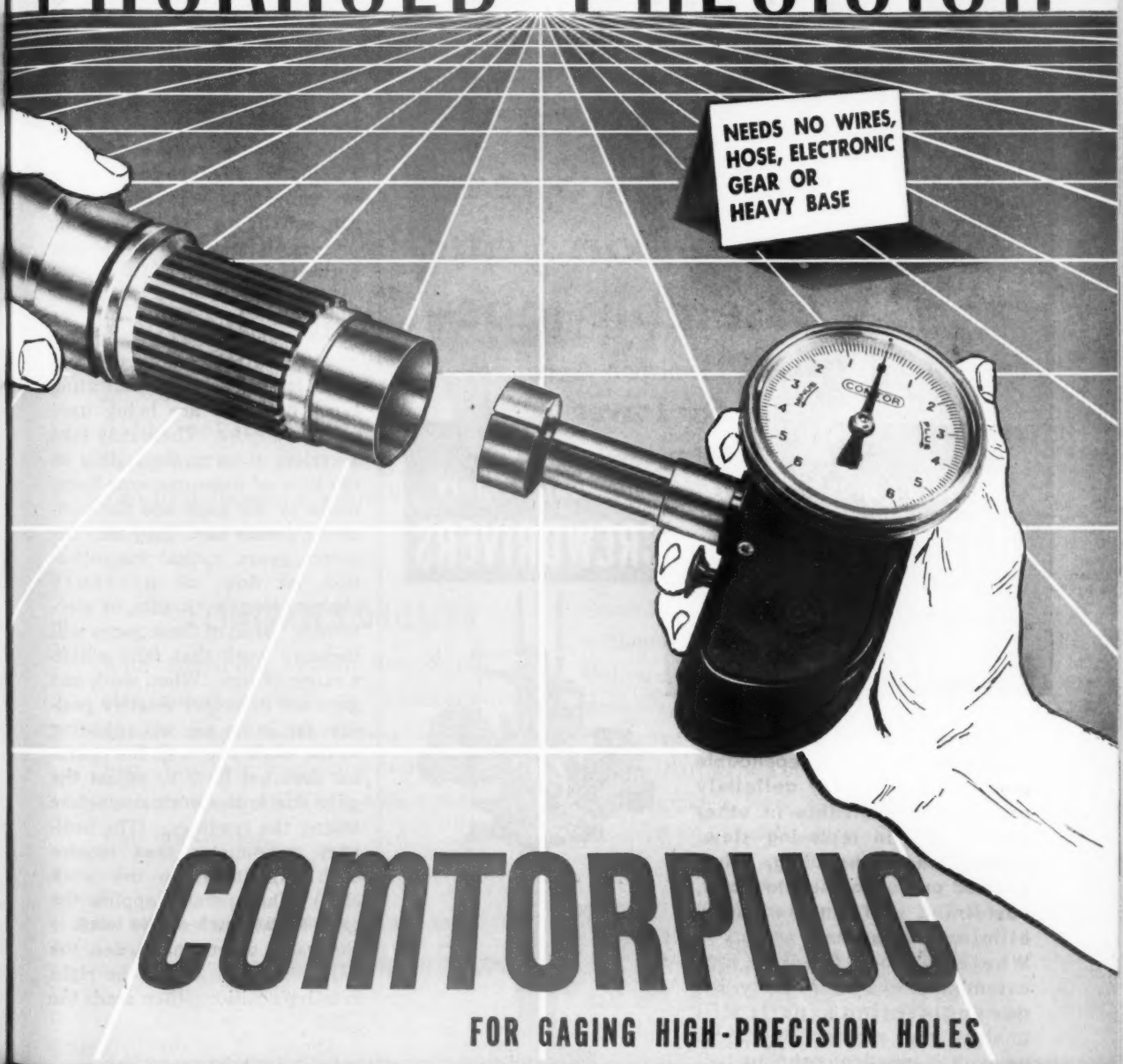
It must be made clear to all concerned that the color spots represent the end of a period of time, and that the gage must not be used beyond the end of that period of time without reinspection. The color spots do not indicate the date of the last inspection of the gage.

When experience shows that the usable period for a given kind of gage should be lengthened or shortened for overall economy, the period length should be changed, but only with the approval of the quality control supervisor or the gage supervisor. If, on inspection, a gage is found to be still usable, but approaching its near limit to the extent that experience indicates the gage could not safely be used through the usual period, then the inspector should shorten the next period to correspond to the remaining wear life in the gage and so color mark the gage for its next inspection. He should also enter the corresponding date in whatever card is used for calling the gage back for reinspection at the end of its usable period.

A policy must be established as to whether the usable periods for all gages should be such that all gages will always last through the period without wearing beyond the permitted gage wear limit. It may be economically sound to set the periods of time between gage inspections such that as many as 10% of the gages, upon reinspection, will be worn beyond their wear limits. Any such percentages of gages permitted to go beyond their wear limits, would, of course, vary with different kinds of work and different accuracy tolerances. Very critical work might require that only 5% of the gages be allowed to go beyond their wear limits during

. . . Continued on page 78

"PACKAGED PRECISION"



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FOR GAGING HIGH-PRECISION HOLES

REQUEST NEW BULLETIN NO. 46

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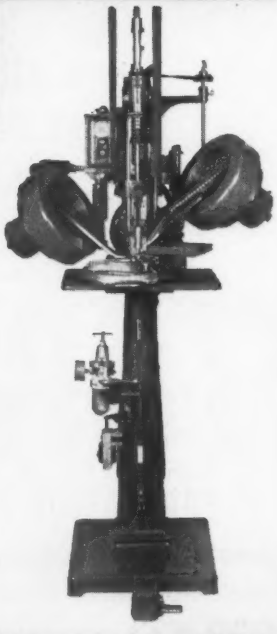
Yes, We Can Prove It!

by Using these Modern Mechanical Helpers

DETROIT POWER SCREWDRIVERS and Motorized HOPPER UNITS



These popular, advanced machines offer a fast, dependable method of assembly definitely proved indispensable in other plants . . . In replacing slow, tedious manual handling, it has boosted production substantially, sustaining uniform results by eliminating human error . . . Whatever your feeding and assembling operations may be, our engineering experts will analyze your problem and come up with a practical solution . . . Give us details . . . Send sample assembly.

DETROIT POWER SCREWDRIVER CO.

2827 W. FORT ST. DETROIT 16, MICH.

. . . Gage Control, from page 76

their established use periods. On the other hand, the period may be considered right when as many as 15% of the gages returned for inspection are found to be worn beyond their wear limits. When gages are to be used in different parts of a plant or shop and on different kinds of work — the same gage being available for use under any of these conditions — then the usable time must be set according to the safe wear period of the gage under the worst conditions. Templates and other gages which are subject to very little wear can usually be safely used for periods of three to six months between inspections.

Indicating Gages

For gage economy and for quality control charting of product dimensions, the indicating types of gages are being used more and more. These may take a variety of forms depending on the kind of measurements being made by the gage and the indicating means used. They may use levers, gears, optical magnification, air flow, air pressure change, electric circuits, or electronics. Most of these gages will measure work that falls within a range of size. When work and gage are in proper relative position the gages are self-adjusting to the work size, i. e., the operator does not have to adjust the gage size to the work size before taking the readings. (The ordinary micrometer **does** require such adjustment to the work size.) The operator applies the gage to the work or the work to the gage, determines when the gage and work are in the right relative positions, then reads the gage.

Almost all of the indicating types of gages require masters for setting them. Some of these masters are simple plug or ring masters. Gage blocks are sometimes usable as masters. Some masters resemble the work and

. . . Continued on page 81

FOR PRODUCT INFORMATION USE CONVENIENT INFORM-A-GRAM CARD

HOW GRAPH-MO® HOLLOW-BAR CUTS COSTS OF RING-SHAPED TOOL STEEL PARTS

1. MACHINES 30% FASTER

Free graphite in Graph-Mo's® structure cuts machining time 30% over other tool steels. It has a minimum tendency to pick up, scuff, seize or gall. It's also the most stable tool steel ever made. A typical Graph-Mo steel master plug showed less than 10 millionths of an inch dimensional change in 12 years!

2. ELIMINATES DRILLING

With Graph-Mo Hollow-Bar, drilling is eliminated because the center hole's already there. Finish boring is the first step. You save machining time. Available in sizes up to 16″ O.D. with a variety of wall thicknesses.

3. OUTWEARS OTHERS 3 TO 1

The combination of free graphite and diamond-hard carbides gives Graph-Mo unusual wear-resistance. Reports from users prove it outwears other tool steels an average of 3 to 1. And Graph-Mo responds uniformly to heat treatment.

4. MORE PARTS PER TON

You start closer to your finished product with Graph-Mo Hollow-Bar. You machine away a minimum of steel, cut scrap loss. Graph-Mo Hollow-Bar is distributed through A. Milne and Co. and Peninsular Steel Co. warehouses. For more information about Graph-Mo Hollow-Bar, write The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO."

YEARS AHEAD—THROUGH EXPERIENCE AND RESEARCH

SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS TUBING

SEE ADVERTISERS INDEX, BACK OF BOOK, FOR INFORM-A-GRAM KEY NUMBERS

ELGIN'S "Layers of water"

PRODUCE A BETTER ABRASIVE

Water . . . an important ingredient for segregating the tiniest diamond particles in a unique Elgin process . . . a vital step in producing a precision abrasive! After pure diamond bort has been shattered and mechanically sieved into 10 grades, the finest sieve grade is placed in a large glass vessel of pure water, mixed into a slurry and allowed to settle. The heavier, larger particles sink faster . . . forming cloudy "layers" suspended in the water. At specified intervals, an Elgin-developed process removes these "layers of water", thus segregating the various weights of diamond powder while still in suspension. The result is absolute particle uniformity . . so necessary in producing a precision abrasive for precision finishes.

Every step of production, from crushing and grading to the finished DYMO product, is performed in Elgin laboratories under the strictest quality standards. Where only the finest, most reliable abrasives can be used . . . be sure to FINISH WITH DIAMOND . . . ELGIN DIAMOND!

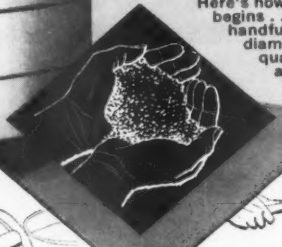
Ask for a free demonstration!

ABRASIVES DIVISION

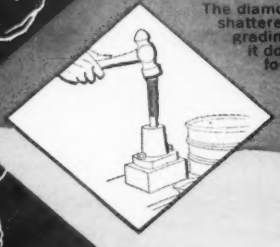
ELGIN NATIONAL WATCH COMPANY

ELGIN, ILLINOIS

Dept. D



Here's how all Elgin Diamond begins . . . in an $8,000 handful of pure, virgin diamond bort, the finest quality obtainable for abrasive production.



The diamond bort is shattered at the start of the grading process . . . breaking it down into fine particles for further separation.

A special "shimmy" machine vibrates the diamond powder, separating it into 10 graduated sieves with meshes from 1600 to 105,625 openings per sq. in.

Following the "layers of water" process, a final inspection checks the graded diamond dust for correct particle size and grade . . . ready for compounding into its vehicle.

. . . Gage Control, from page 78

have all the pertinent dimensions of the work.

Masters also must be measured occasionally to assure their accuracy. The interval of time between inspections depends upon the conditions and the frequency of their use. The danger is that they will last so long because of infrequent use and light contact of the gaging members that it becomes taken for granted that they are eternally perfect. Here again a card record indicating the last inspection of such master gages—flagged for inspection at a given later date—is essential. Expensive contour gages are sometimes accepted with known errors which would be very expensive to correct. These known errors are taken into account in the setting of adjustable gages to the master. The adjustable gage is then set to read the known actual dimension of the master.

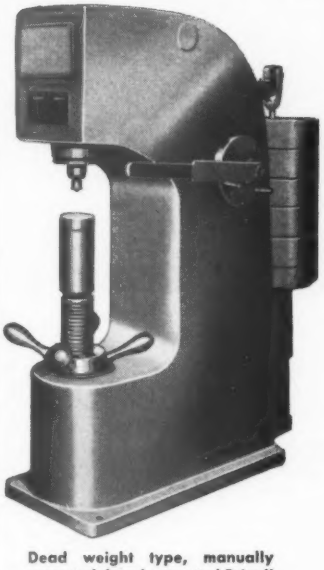
Gage Room Requirements

Accurate gage measurements require control of the temperature at which the gages are measured. Most gage manufacturers maintain the temperature of their gage inspection rooms to the International Standard of 68° F (20° C). The reason for maintaining a very close temperature range is that all materials expand with a rise in temperature and contract with a drop in temperature. For example, a pin gage 24" in length increases 1/1000" when subjected to a rise of 6½°. If this same gage were measured anywhere else in the world under the same conditions, the results would be identical.

One important requirement of an efficient gage room is clean air preferably with the humidity maintained between 57% and 59%. This requirement is necessary for the proper functioning and life of the gage equipment as well as for the comfort of the gage room personnel.

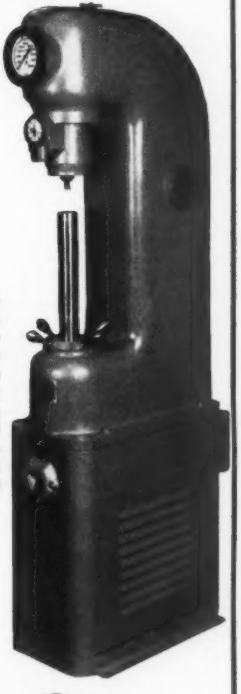
. . . *Continued on page 84*

YOU CAN ALWAYS DEPEND ON *Steel City* TO FURNISH THE *Right* BRINELL HARDNESS TESTER FOR *Your* NEEDS



Individual requirements differ. Laboratory needs are far different from production needs. The Brinell Hardness Tester you buy must be exactly suited to your application. Our complete line of Brinell Testers includes the correct type for practically every need. Our reputation in this field since 1914 proves that if we do not have what you require, we can easily convert one of our standard models to fit your specifications. On this page are illustrations of two typical Steel City Brinell Testers. Other types available include portable, bridge type, deep-throated and long stroke designs and models to fit into your conveyor line. Write to us for a descriptive catalogue or address of our nearest sales representative.

Dead weight type, manually operated, bench mounted Brinell Hardness Tester. Weights are linked mechanically to ball penetrator. Dash pot below weights makes load application gradual and smooth. Instantaneously select any load 500 kg. to 3000 kg. Exceptionally accurate; low maintenance. Also available as floor model and motorized.



Direct reading type, hydraulically operated, motor driven Brinell Hardness Testing Machine for production line testing. "Direct reading" feature eliminates time-consuming use of Brinell microscope, sometimes avoids spot-grinding. Interval timer automatically controls testing cycle. Simplified knee switch operation. Tests up to 800 pieces per hour.

MANUFACTURERS OF MACHINES FOR TESTING PHYSICAL PROPERTIES OF METALS

Brinell, Ductility, Universal, Tensile, Compression, Transverse, Hydrostatic, Special Testing Machines, Flex-Tester and Proving Instruments

Steel City Testing Machines Inc.

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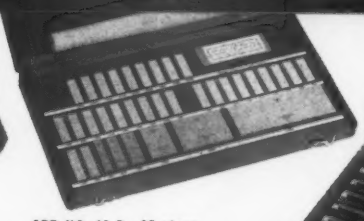
No Finer Accuracy
at any price..

SET NO. 35-S—35 piece square gage block set.
"W" accuracy—$222.50
"I" accuracy—$318.75



SET NO. 35-R—35 piece rectangular gage block set.
"W" accuracy—$195.80
"I" accuracy—$280.50

SET NO. 81-SA—81 piece square gage block set with basic attachments.
"W" accuracy—$545.60
"I" accuracy—$764.35

SET NO. 8-R—8 piece rectangular gage block set.
"W" accuracy—$315.00
"I" accuracy—$402.00

Ellstrom Standards

CHROMIUM PLATED TO GIVE YOU LONGER WEARING MILLIONTHS!

By whatever comparison you care to make, you'll find ELLSTROM Chromium Plated Gage Blocks are outstanding in the field of precision measurement. For example . . .

ACCURACY— They're unconditionally guaranteed to specified millionths of an inch . . . with optical flatness, parallelism, and metallurgical stability to match. And they're backed by the exclusive heritage of ELLSTROM . . . measuring in millionths for three generations!

SERVICE— They give you 5 to 20 times longer life than ordinary steel blocks . . . a fact established by the National Bureau of Standards. (See Research Paper No. 276.) Rated "tops" by leading authorities for all-around gage block quality!

ECONOMY— Right! Chromium plated to give you longer wearing millionths, yet ELLSTROM Standards actually cost no more than many leading makes of ordinary steel gage blocks!

SELECTION— Available in 15 popular standard sets or by individual blocks . . . in both square and rectangular styles. Standard accessories also available to permit their use on an almost unlimited range of precision production and inspection applications.

SET NO. 85-R—85 piece rectangular gage block set.
"W" accuracy—$408.50
"I" accuracy—$556.50

SET NO. 18—Rectangular Gage Block Accessory Set. 18 pieces in the case. Prices on set and individual accessories furnished upon request.

SET NO. 36-R—36 piece rectangular gage block set.
"W" accuracy—$228.25
"I" accuracy—$328.90

ELLSTROM STANDARDS DIVISION
Dearborn Gage Company
22035 BEECH STREET • DEARBORN, MICHIGAN
Originators of Chromium Plated Gage Blocks

Prices on individual square and rectangular gage blocks . . . plus tungsten carbide wear blocks . . . furnished upon application.

(All prices shown subject to change without notice)

Send for complete information today!

ELLSTROM STANDARDS DIVISION, Dearborn Gage Co.

Please send me literature on Ellstrom chromium plated gage blocks and accessories . . . plus complete details on your Gage Block Inspection Service and Trade-In Plan.

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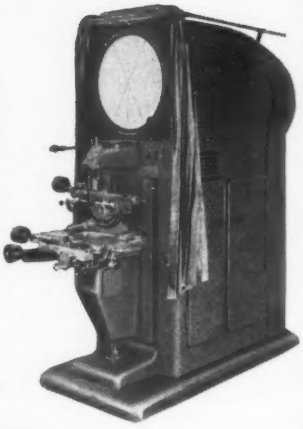
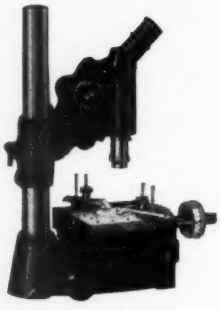
FOR *UNEQUALLED* PRECISION
in measurement, assembly, inspection . . .

CONTOUR MEASURING PROJECTOR

Save time, money, and materials by spotting inaccuracies quickly and simply . . . with highest-precision measurements. You get angular measurements to ± 1 minute of arc with a protractor screen, and direct linear measurements to ± .0001" over a range of 4" by 6" with the cross slide stage. Dimensions, angles and profiles of production-run parts can be compared directly with a *traced* outline of the projected image of the master part, or with a scale drawing superimposed on the screen. Write for Catalog D-27.

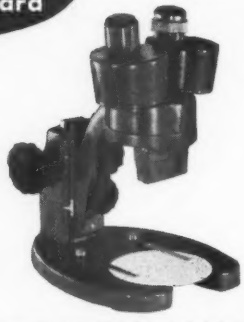


. . . industry's *UNEQUALLED* standard



TOOLMAKERS' MICROSCOPE

This sturdy microscope gives you one inch linear measurements to ± .0001" and angular measurements (with protractor eyepiece) to ± 1 minute of arc. Operation is extremely *simple* and *fast*. Opaque and transparent objects of any contour can be measured. Write for Catalog D-22.



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The finest optical system ever produced for stereoscopic work assures you precision accuracy in small parts assembly operations and in inspection of tools and finished parts. You get clear, sharp, three-dimensional images, and a *wider area of focus than ever before*. The magnified image is erect and *unreversed*, for easier interpretation by the average user. These sturdy, dustproof microscopes are extensively used in industry, either alone or incorporated into machine tools. Write for Catalog D-15.

1853/1953 INTO A NEW CENTURY OF OPTICAL PROGRESS
BAUSCH & LOMB CENTENNIAL

WRITE for complete information on these efficient optical aids. You may be paying many times over their moderate cost in lost time and rejects. Bausch & Lomb Optical Co., 79822 St. Paul St., Rochester 2, N. Y.

Bausch & Lomb *Quality Control* Instruments

. . . Gage Control, from page 81

Conditioned air is usually conducted to ducts located in the ceiling near the middle of the room, distributed at low velocity to prevent drafts throughout the room, withdrawn through ducts with controllable registers located in the base boards, and brought back to the filtering and conditioning equipment.

For best temperature control, the room should be completely insulated, including the ceiling. Outside walls should be avoided.

Fluorescent lighting is the best type of illumination for such rooms. Heat transfer from the lights should be kept to a minimum. If natural daylight is used, it should be from the North.

Battleship linoleum of a light tan is usually used as floor and bench covering. The room should be kept scrupulously clean at all times. This pays off in better inspection and in greater respect for gages.

To prevent sudden temperature changes, the entrances are protected by vestibules; and, where possible, service in dispensing and receiving gages is rendered through small windows.

The main object of this type of room is to maintain the air at a constant temperature. Large masses of metal, such as surface plates, assist in bringing gages to this temperature if they are allowed to remain in contact with such surfaces long enough. Some gage manufacturers go so far as to put gages that are to be measured in a bath of Toluol to bring them to measuring temperature. For extremely accurate measurements, all possible precaution is taken against heat transfer to the gage and the gage inspection equipment from the hands or body of the gage inspector.

Mr. Borneman's article on "Gage Control System" was presented as a technical paper before the Seventh Annual Convention of the American Society for Quality Control, held at Convention Hall, Philadelphia.

FOR PRODUCT INFORMATION USE CONVENIENT INFORM-A-GRAM CARD

Announcing...

a new service from Ampco

AMPCO* METAL

Grade 24 Die Blanks!

now available from stock

. . . the dies for forming and drawing stainless steels that give longer runs, reduce scrap, cut your costs.

This is good news for everyone who makes drawn or formed stainless parts. Now you can get immediate delivery on 70 sizes of solid rounds, rectangles, and centrifugally-cast rings *at new low* prices for your stainless drawing, forming, or bending operations.

Die blanks of Grade 24 Ampco Metal have become so popular that commonly used sizes are now available promptly from Milwaukee stock. Types and sizes include:

34 sizes of solid rectangular pieces from ½"x1"x12½" to a maximum of 4"x4"x12½".

27 sizes of centrifugally cast blanks from 4" OD x 1" ID x 1½" thick up to 20" OD x 12½" ID x 2" thick.

11 sizes of solid rounds up to 5" OD x 12½" long.

The popularity and wide acceptance of this special alloy for forming or drawing stainless or similar materials is due to these advantages — advantages you get only with Ampco Grade 24:

1. **Your usual scrap losses are minimized** because Ampco grade 24 dies are non-galling, non-loading.

2. **Less time is required for finishing operations** . . . your costs are cut. Grade 24's unique bearing qualities and low co-efficient of friction eliminate scratches and die marks on surface of pieces drawn.

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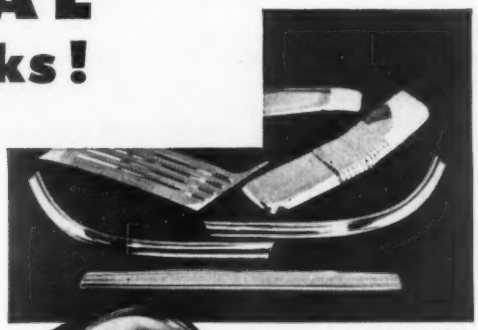

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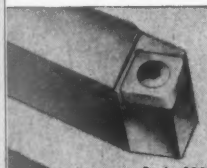
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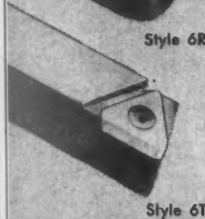
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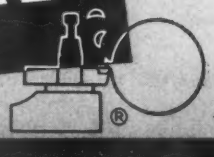

INSTRUMENTATION QUALITY

MANY modern production processes are of the type that turn out the same piece over and over again. It is on this repetitive-type production, and in particular on high-speed production of this type, that instrumentation for statistical quality control can be used to the best advantage.

The packaged-foods industry has the very real problem of controlling the weights of its products. Underweight packages cannot be tolerated. Federal and local laws and the packager's integrity demand that the net contents of a package be at least as much as the label indicates. Overweight packages, of course, are undesirable also. Although packaged-food producers purposely overfill in order to avoid damaging underweight packages, they cannot afford to give away any more product than is absolutely necessary. The general package-weight control problem then is one of intentionally overfilling by just enough to insure that no underweight packages go out.

Overfilled packages, as well as underfilled ones, can cause poor customer relations by an unexpected and unwanted failure in the kitchen.

Many production processes have similar control problems. Dimensions, resistance, hardness, and color are but a few of the physical variables that might be desirable to control in a production process. It is obvious that the reasons for desiring control may not be even remotely related to those described for package-weight control. However, the problem of controlling the variable so that its variation around a desired nominal value is reduced to a minimum, may be exactly similar to controlling package weights about a nominal value (generally slightly larger than the label net weight).

The Production-Line Package-Weight Control Problem

In practically all modern packaging lines, the packages are

This article has been adapted from a paper delivered by the authors before the Eighth National Instrument Conference, held in Chicago October 21-25, 1953, under sponsorship of the Instrument Society of America.

FOR STATISTICAL CONTROL

by W. Hecox and R. L. Merrill

Assistant Supervisors
Electrical Engineering Division

BATTELLE MEMORIAL INSTITUTE
Columbus, Ohio

filled automatically. The filling machines like any other machines are not perfect. There will be variations between consecutively filled packages as well as between packages filled at considerably different times. This situation is aggravated by changes in the density of the material being filled, by changes in its flow characteristics, and by changes in the head or amount of material in the hopper. The high-speed operation of modern packaging lines serves to amplify the variation in package weights, particularly between consecutive packages. At these high filling rates of 60, 70, or even 100 or more packages per minute, the material flow may be irregular, and the cutoff point for the filler may not be reliable.

Chance and Assignable Causes

The variations between consecutive package weights are variations that are due to, or at least may be treated as though they were due to, chance causes. These inherent variations, which are called random or chance variations, are such that the variation between two consecutive package weights provides no specific measure of how much the next package weight will vary.

The random or chance variations from package to package will be distributed about some average value of package weight. Decisive changes in this average value of package weights are attributed to assignable causes. The assignable variations are generally longer term variations that occur over a number of packages. If assignable variations or shifts in the average package weight can be distinguished from the random or chance variations, the process can be adjusted to correct for them.

A package-weight control system is limited in its effectiveness

. . . *Continued on page 90*

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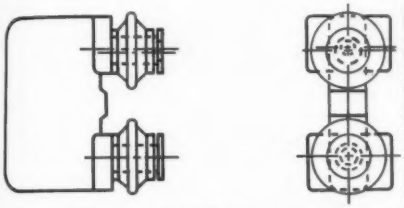
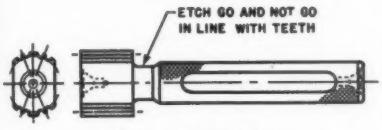
. . . Splines, from page 72

type tooth thickness snap gage, Fig-8, performs the same function as the paddle plug performs in the splined hole. It controls the actual tooth thickness and achieves the same effect as an over pin check. The Go roller type snap gage controls the maximum actual tooth thickness. The Not Go gage controls the minimum actual tooth thickness. These gages have an eccentric adjustment



ROLLER TYPE SNAP GAGE



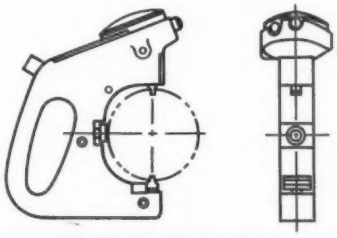
SET MASTER

FIGURE 8

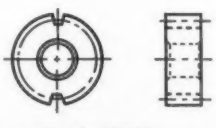
for initial settings and re-settings necessary to compensate for wear. The settings are made to a set master which usually incorporates the Go and No Go size.

The indicator tooth thickness snap gage shown in Figure 9 not only controls, but also measures the actual tooth thickness of external splines. Like the roller type snap gage, its function is similar to a check over pins. It is superior to the roller type snap gage because one indicator gage will not only control the Go and Not Go limits but also report the amount and range of manufacturing varia-

. . . *Continued on page 173*



INDICATOR SNAP GAGE



SET MASTER

FIGURE 9

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. . . Instrumentation, from page 87

by its inability to distinguish between assignable variations and random or chance variations. Optimum control is obtained when the only remaining variations are the random or chance variations.

Present Status of Package-Weight Control

At present, nearly all of the package-weight control systems are manual control systems. A few of the packages are taken off the line and manually checkweighed on an equal-arm balance. Manual adjustments to the filler are then made, based on the information received from the checked packages.

The simplest and most commonly used form of manual control is as follows:

1. A girl stands or sits alongside the line behind the filler and periodically sets off and checkweighs a package. On high-speed lines she can at best check only one out of every 10 or 20 packages.
2. On the basis of the weight of this single package she judges when and how much the filler should be adjusted. She usually shouts instructions to another girl up the line who actually adjusts the filler.

The second form of manual control involves simple statistical techniques and is as follows:

1. A girl periodically sets off several packages (usually four or five) after they have been filled. She weighs each of them and records their weights.
2. She then calculates the average weight for the group of packages and plots this on an especially prepared chart. She also calculates the range of the weights, which is the difference between the heaviest and the lightest package in the group and plots this on a chart.
3. So long as the averages and ranges are between limit lines on the chart, she takes no action. If the average is beyond one of the limits she makes an adjustment to the filler. If the range is beyond a limit line she informs the line supervisor.

Both these forms of control are inadequate for high-speed production lines. The first or single-package method depends entirely on operator judgment based on insufficient data. The second method, which is actually a statistical control chart for variables, has a mathematical basis for judging when action should be taken and sufficient data on which to base this judgment. However, this second method is limited by the time that it takes to obtain the weight information and process it to decide if action should be taken. Fifty, one hundred, or even several hundred packages may go by before a needed adjustment to the filler would be effected.

Control Charts for Variables

Statistical control charts for averages and ranges are a convenient means for distinguishing between assignable variations and pure chance or random variations. If the only variation in the process is the normal random or pure chance variation, the averages for equal-sized groups of items will have a certain probability of being within calculated limits. This is also true of the ranges or other statistical measures of the process spread. If the average for a group of items is beyond a previously calculated limit, there is a very good chance

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that there is an assignable variation in the process. If the range is beyond a limit, there is a very good chance that the inherent or random cause system has been altered. That is, in the case of a packaging line, an over-limit range means the filler is not doing as good a job of filling consecutive packages as it had previously been doing.

Charts are provided with parallel dotted lines representing standard sigma control limits, which are calculated from manually obtained weight data. Upper and lower limits are so established that points plotted beyond the limits indicate that there are assignable variations.

Automatic Control Chart Plotter

An automatic control chart plotter has been developed. This automatic plotter (for averages and ranges) will compute the averages and ranges and record them as rapidly as the packages can be checkweighed. When this automatic plotter is used in conjunction with an automatic checkweigher, packageweight statistics may be computed and recorded for all the packages being produced on lines running at speeds up to 100 per minute.

The automatic checkweigher weighs each package and produces a voltage that is proportional to its weight deviation relative to a nominal package weight. The checkweigher also produces an electrical signal to indicate when each package has been properly weighed.

The averager computes the average for the selected number of package weights received from the checkweigher. The sample size may be selected in advance to be any size from about five to fifty. Its input is a voltage from the checkweigher and its output is a voltage proportional to the average of the input voltages.

The range computer computes the difference between the maximum and minimum voltages (in each sample size) received as input signals from the checkweigher. Its output is a voltage proportional to this range.

The averager and range computer must function independently of time. That is, they must reliably compute the average and range, whether the packages are being weighed rapidly, or slowly, or at varying rates.

The recorder, therefore, has an intermittent chart drive. The chart drive operates for a two-second interval while the average and range are recorded and then is stopped until another average and range are ready to be recorded.

Lights above the recorder correspond to the control limits. They are lighted whenever the average and/or the range exceeds that particular limit. The lights may be located remotely. The recorder used in this plotter is a standard twin-chart Esterline-Angus recorder with d-c voltmeter movements. Below the recorder are the limit and recorder controls, the range computer, the averager, and the power supplies. The three upper panel chassis are of drawer-type construction.

Averager and Range Computer

The averager and range computer in their simplest forms consist of only switches or relays, capacitors, and vacuum diodes.

The averager functions by charging equal-sized capacitors

. . . *Continued on page 98*

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FIRST STEPS IN ESTABLISHING A STATISTICAL QUALITY CONTROL PROGRAM

by Michael P. Agresta
SQC Engineer, Pesco Products Division
BORG-WARNER CORPORATION
Bedford, Ohio

It has been stated in several articles on Statistical Quality Control that the average time required to firmly establish an adequate SQC program is about five years. Pesco Products started its program four years ago and it is just now reaching the point of being a sound, practical, and efficient one. So it can be seen that the five year time average certainly holds true as far as the SQC system at Pesco Products is concerned.

One of the primary purposes of this article is to show how an SQC program can be initiated in a smaller organization without the expense of hiring a staff of statisticians, analysts, and experts. Just one man with a knowledge of statistics and ability to conduct a training program devoting full time to SQC is sufficient to start, with additional help being added as it is needed. It should be stated here that the initial, intermediate, and final function of any statistical quality control program is a selling factor.

The most logical person to be contacted and sold in the initial selling of SQC is the chief inspector. In many companies the chief inspector answers only to the president and it is he who can do the most good in laying down the foundation of initiating quality control by selling the idea to top management. Emphasis is strongly placed on the "selling of management" before any success of a statistical quality control program can be inaugurated. The mere consent from the top executives to begin a quality control program is not enough evidence to prove that they have been sold on the idea. They must be shown percentagewise and dollarwise the advantages of the additional overhead which they are undertaking. A word of caution here is that a list of fantastic promises is not very logical. Statistical quality control is not the answer to every employer's prayer, it has its shortcomings. Yet if used properly it has proven itself to be a very beneficial tool in industry. Like any other tool, it is only as good as the operator using it.

The best approach in driving home quality control by statistical methods to management is by a short, concise, but complete series of lectures or a training program on the subject. Even a one week schedule of one hour a day, or any equivalent five hours, for explanation to the heads and

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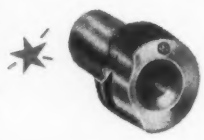

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keymen of engineering, production, inspection, and other departments would be sufficient enough to show these men the advantages of statistical quality control within their organizations. At least it should create enough interest for them to ask for more enlightenment on the subject.

As their interest becomes greater, more detailed information should be supplied. As a general rule, men at the top management level have very little time to devote to a training program. Therefore, if the initial driving force in the brief lecture carries enough impact to cause them to ask for more information on the subject, then the beachhead has been established.

The general subject matter for the lectures to management should include an explanation on some of the following items:

(1) Method and advantages of obtaining machine or process capabilities.

(2) How the nature of a lot of material can be determined from a small random sample.

(3) Methods of obtaining "in-process" control.

(4) Advantages of statistical sampling in inspection.

(5) How statistical data can be used for trouble-shooting surveys.

All of the above listed items are very important and interesting subjects to the men in the top management level. Consequently, a short but thorough explanation on each of these topics should be made.

(1) Process Capabilities Once the mechanics of the mathematical computations in obtaining capabilities has been shown then the list of methods for obtaining these capabilities is in order. Take for example a troublesome dimension on a part of a repetitive nature. This would automatically call for a capability survey. If the machining capability is less than the given tolerance then it is strictly operator trouble in not centering his work. However, if the capability is greater than the given tolerance (which is generally the case) then the following steps should be taken to pin point the source of trouble and get the necessary corrective action. By a process of elimination it can be determined whether the operator, machine, or fixture is at fault. Checking the day and night operators' work can eliminate the operator as the source of trouble, and using the same fixture on two or more machines can show whether it is the machine or the fixture and tooling that is causing the trouble. When the trouble has been pin-pointed to a fixture or machen then a discussion with the proper personnel in engineering, methods, and standards can arrive at a decision on whether to "open-up" the print to meet the tolerance that the setup is capable of holding, or get the necessary tooling to meet the given tolerance, or to accept a certain percentage of discrepant material each time the job is run.

(2) Determining the nature of a lot from a small sample. A good random sample (based on computed mathematical probabilities and generally about 10% to 15% of the lot) during a machining process can predict with ap-

. . . *Continued on page 97*

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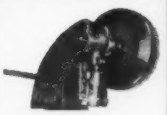

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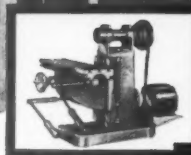

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TANTUNG 144

A new catalog issued by the Vascoloy-Ramet Corp. introduces Tantung 144 to the metal cutting tool field. Includes photos, line sketches showing dimensions plus application drawings on Tantung tipped tools.

Circle Inform-A-Gram No. E1

MILLING MACHINES

This Sundstrand Machine Tool Co. catalog illustrates some typical uses of the firm's Vertical Rotary Rigidmil milling machines. Also included are machine cycles, specifications and dimensions.

Circle Inform-A-Gram No. E2

OPTICAL COMPONENTS

The Industrial Division of W. & L. E. Gurley offers this Quick-Pic catalog on precision products for science and industry. Covered are optics, reticles, circular scales and linear scales.

Circle Inform-A-Gram No. E 3

DIE SUPPLIES

Full details and dimensions of Lamina Guide Bushings are contained in this illustrated catalog. Information on a variety of other Lamina tools, dies and job proven die making equipment also included.

Circle Inform-A-Gram No. E4

MEASURING FLATNESS

The care and operation of Lapmaster Monochromatic Lights and Optical Flats for measuring flatness with light bands is a feature of a lapping equipment catalog put out by Crane Packing Co.

Circle Inform-A-Gram No. E5

DIES

Monocone and Duocone dies and die holders, made by Pratt & Whitney, are illustrated and described in this brochure. The circular contains sizes, specifications and other valuable data.

Circle Inform-A-Gram No. E6

DIE SETS

Here's a 24-page booklet on the die sets produced by the Superior Steel Products Corp. The design features of Superior die sets are aimed at solving die set handling problems from bench to press.

Circle Inform-A-Gram No. E7

HYDRAULICS

The purpose of this booklet is to better acquaint users with the basic needs of hydraulic systems. This Vickers catalog also has a table of common hydraulic system difficulties and recommended corrective action.

Circle Inform-A-Gram No. E8

JIG GRINDER

Contents of this Moore Special Tool Co. catalog includes data on the firm's Model No. 2 precision jig grinder. The booklet shows typical production jobs and the versatility and range of the machine.

Circle Inform-A-Gram No. E9

WORK DRIVER

Description, illustrations and specifications of various types of automatic work drivers for engine lathes, multiple tool lathes and grinders made by the Seneca Falls Machine Co., are contained in Bulletin D-43.

Circle Inform-A-Gram No. E10

INDUCTION HEATING

This catalog illustrates some of the many ways in which induction heating equipment, made by Lepel High Frequency Laboratories, Inc., is performing metal heating jobs.

Circle Inform-A-Gram No. E11

FORGINGS

Brass, bronze and aluminum forgings are described in detail in a well-illustrated booklet available from the Mueller Brass Co. How forgings are made by this large supplier is an added feature of the catalog.

Circle Inform-A-Gram No. E12

CYLINDERS

High pressure cylinders for hydraulic operation, made by the Hanna Engineering Works, are described in Catalog No. 233A. Booklet contains a wealth of information on "cylinder power."

Circle Inform-A-Gram No. E13

TUBULAR CONVEYORS

Here is a general catalog from Hapman Conveyors, Inc., which briefly describes the firm's various types of tubular conveyors and accessory equipment. A composite picture is presented of many features and of installations.

Circle Inform-A-Gram No. E14

"PUSH-BUTTON" DRILLING

This recent catalog gives photos of single and multiple installations of Drillunits. Folder tells of this new power-source for operating drills and cutting tools.

Circle Inform-A-Gram No. E15

PRODUCTION SHAPER

Outstanding features of the Wotan Type Hercules 22 V-Ram high speed production shaper are given in a catalog offered by the Parker Machine Co. Essential features of the machine are pictured and fully described.

Circle Inform-A-Gram No. E16

SEE ADVERTISERS INDEX, BACK OF BOOK, FOR INFORM-A-GRAM KEY NUMBERS

. . . Receiving, Q. C., from page 51

TIGHTENED INSPECTION

Lot Size	Sample Size	AQL 0.5% ac	0.5% re	2% ac	2% re	5% ac	5% re
41- 65	25	0	1	1	2	3	4
66- 110	35	0	1	2	3	5	6
111- 180	50	1	2	3	4	6	7
181- 300	75	1	2	4	5	9	10
301- 500	110	2	3	6	7	12	13
501- 800	150	3	4	8	9	17	18
801- 1,300	150	3	4	8	9	17	18
1,301- 3,200	225	4	5	11	12	24	25
3,201- 8,000	300	5	6	14	15	32	33

NORMAL INSPECTION

Lot Size	Sample Size	AQL 0.5% ac	0.5% re	2% ac	2% re	5% ac	5% re
41- 65	10	0	1	0	1	1	2
66- 110	15	0	1	1	2	2	3
111- 180	25	0	1	1	2	3	4
181- 300	35	0	1	2	3	5	6
301- 500	50	1	2	3	4	6	7
501- 800	75	1	2	4	5	9	10
801- 1,300	110	2	3	6	7	12	13
1,301- 3,200	150	3	4	8	9	17	18
3,201- 8,000	225	4	5	11	12	24	25

REDUCED INSPECTION

Lot Size	Sample Size	AQL 0.5% ac	0.5% re	2% ac	2% re
41- 65	5	0	1	0	1
66- 110	7	0	1	0	1
111- 180	10	0	1	0	1
181- 300	15	0	1	1	2
301- 500	25	0	1	1	2
501- 800	35	0	1	2	3
801-1,300	50	1	2	3	4
1,301-3,200	75	1	2	4	5
3,201-8,000	150	3	4	8	9

Fig. 3. A convenient form of sampling plan, showing Normal, Tightened, and Reduced sampling. This plan is adapted from MIL - STD 105A and permits selection of acceptable quality level to suit specific conditions that prevail.

the relative risk of accepting a lot which contains a larger percentage of defectives than is permissible by the prescribed acceptable quality level. He should also have some knowledge of the risk of rejecting a lot which has a smaller percentage of defective units than would be acceptable under the prescribed acceptable quality level. The risks are defined by the "operating characteristic curve" of the particular sampling plan he is using. A typical operating characteristic curve is shown in Figure 1.

Of course, the percentage of defective items in the submitted inspection lots is not known. However, this is equivalent to the "process average," and this figure may be used for determining the risk of accepting a bad lot or rejecting a good lot. If the process average is higher than the acceptable quality level, the probability of rejecting a lot is correspondingly higher. Hence, for the successful operation of a sampling plan with a minimum risk of rejecting a large percentage of lots, the process average, or the percent defective in submitted lots, should be smaller than the acceptable quality level.

It is important that the inspector in the receiving department make a record of every lot sampled to determine the process average and to detect probable trends in quality in succeeding lots. A convenient method of recording such inspections is shown in Figure 2. It will be noted that this card must be filled out front and back. The back is used for special notes describing the nature of the defects which have been found in previous samples, and to point out particular characteristics to which the inspector must pay particular attention.

From time to time, these cards are reviewed to note if there is any significant differences in the quality of products submitted by several suppliers, or if lots from a particular supplier are rejected more often than others. This information is brought to the attention of the purchasing department. Armed with this factual information, the purchasing department is in a strategic position to discuss the matter with the responsible supplier with every expectation that the supplier will improve the situation.

This simple system of sampling requires that the quality control department establish an acceptable quality level for each product, and that a suitable sampling plan be designed for use by the inspector. A convenient sampling plan (adapted from MIL-STD 105A) is shown in Figure 3. The acceptable quality level, as has been stated, is determined after consideration is given to the hazard of allowing defective units to pass, the cost of inspection, the unit cost of the product, and the manufacturing difficulties of producing the item.

The important thing to bear in mind is that the sampling plan adopted must be followed to the letter, whether the plan used is one described in MIL-STD 105A, or one calculated by the quality control department, in accordance with accepted statistical principles. Concessions and compromises must not be made either in the size of the sample or in acceptance or rejection numbers. A decision must be made regarding acceptance or rejection of the lot strictly in accordance with the results of the inspection of the sample.

These methods have been instrumental in reducing receiving department inspection costs by as much as 60 percent and in reducing rejections by as much as 70 percent to 75 percent.

. . . Receiving, Q. C., from page 51

TIGHTENED INSPECTION

Lot Size	Sample Size	AQL 0.5% ac	0.5% re	2% ac	2% re	5% ac	5% re
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66- 110	35	0	1	2	3	5	6
111- 180	50	1	2	3	4	6	7
181- 300	75	1	2	4	5	9	10
301- 500	110	2	3	6	7	12	13
501- 800	150	3	4	8	9	17	18
801- 1,300	150	3	4	8	9	17	18
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3,201- 8,000	300	5	6	14	15	32	33

NORMAL INSPECTION

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66- 110	15	0	1	1	2	2	3
111- 180	25	0	1	1	2	3	4
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3,201- 8,000	225	4	5	11	12	24	25

REDUCED INSPECTION

Lot Size	Sample Size	AQL 0.5% ac	0.5% re	2% ac	2% re
41- 65	5	0	1	0	1
66- 110	7	0	1	0	1
111- 180	10	0	1	0	1
181- 300	15	0	1	1	2
301- 500	25	0	1	1	2
501- 800	35	0	1	2	3
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1,301-3,200	75	1	2	4	5
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These methods have been instrumental in reducing receiving department inspection costs by as much as 60 percent and in reducing rejections by as much as 70 percent to 75 percent.

First Steps from Page 93

proximately 95% accuracy the extent and percentage of the lot that will fall outside of print specifications. This is very valuable information to have during a machining process because corrective action can be taken before the damage is done.

(3) Methods of obtaining "in-process" control. This topic has a close tie-in with (2). Process control charts placed on various machines during processing give the operators a visual roadmap picture of the nature of the work. Checks from periodic samples are placed on the charts and all concerned are instructed that as long as these checks fall within the predetermined control limits placed on the charts there need be no fear of making scrap or rework. However, as soon as the points start falling outside of these computed limits it is a signal that trouble is in the making. At this point an investigation should be conducted to determine the cause of the abnormal condition.

(4) Statistical sampling. Any organization that has expended time and money inspecting parts on a 100% basis will certainly appreciate the advantage of checking to a statistical sampling plan. In screening (100% inspection), all product is inspected and each item is accepted or rejected; in lot-by-lot sampling inspection, only part of the product is inspected, and groups of items called inspection lots are accepted or rejected as a whole. Every sampling inspection plan automatically involves a risk. However, if this risk can be held within predetermined limits then the necessary margin of safety assurance will prevail. Statistical sampling plans based on either the military 105-A specification or Dodge-Romig plans give the important ease-of-mind feeling that your sampling inspection is being conducted on a scientific, calculated risk basis.

The many kinds of sampling inspection plans group operationally into three types, which are single, double, and sequential plans. The plan that is best for one product and supplier may not be best for another. It is important to choose the plan that is best suited to the product and supplier in question. The stability of a plan can be judged only in terms of its properties: the assurance given by the plan that inspection lots of high quality will be accepted and inspection lots of low quality rejected, the amount of inspection required by the plan, the extent to which the plan encourages the supplier to improve the quality of product submitted, the ease with which the plan can be administered and operated.

(5) Statistical data for trouble-shooting surveys. There are many instances in which statistical data can be used for trouble-shooting surveys. To cite but a few of these instances, it can be shown that subsequent operation in the machining of certain parts are responsible for distorting dimensions on previously run operations, or that there is a direct correlation between the core hardness of a certain steel part to the specified shear-breakage and the range of core hardness necessary to hold this specified shear breakage. Or, as another example, the growth

. . . *Continued on page 101*

For Years, Milne Has Been Delivering Hollow Die Answers* To Tooling Problems..
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. . . Instrumentation, from page 91

to voltages corresponding to the values to be averaged and then connecting them in parallel to obtain the average voltage.

The range computer functions by charging a pair of equal-sized capacitors through a pair of vacuum diodes. The diodes are arranged so that one capacitor can charge positively and the other negatively. The capacitors are initially charged so that the diodes conduct when the first voltage is applied. Thereafter, no more than one capacitor will charge according to whether the applied voltage is more or less positive than any voltage previously applied. The voltage difference between the two capacitors is proportional to the range of the voltages applied.

Automatic Filling-Machine Control

The automatic control chart plotter can be readily adapted to adjust the filling machine by means of a servo drive system. The control comparator is essentially the same as the circuit used to light the limit lights on the automatic chart plotter. It provides a signal when a limit is exceeded and also produces a voltage that is a function of how much the limit is exceeded. The voltage that is produced by the control comparator serves as the input to a progressive position servo. The servo positions the filler adjustment mechanism (usually a knob or a handwheel) according to how much the average package weight is beyond the control limit.

Conclusions

The application of statistical control methods to production processes in the past decade has demonstrated their usefulness in detecting trouble, reducing waste, and improving product quality.

Instrumentation for automatic or semiautomatic statistical quality-control systems will permit the more effective application of statistical methods to the relatively higher rate of production processes.

These instruments may also provide a more adequate form of statistical control than some low-speed manual statistical operations, since more items can be checked, and the cost of labor may be reduced.

The authors wish to thank the Exact Weight Scale Company for permitting this information to be presented for publication.

INDUSTRY NEWS

(The Carboloy Department of General Electric Company,) Detroit, has revealed that it has been engaged for a number of years in a research program to develop a high temperature resistant material for jet engines.

The program is centered around a search for a material which can be used in turbine bucket blades. With a high heat resistant material, it would be possible to operate the turbine at greater internal temperatures and increased thrust.

Heat problems encountered in jet engine buckets are similar to those found in cutting tools where high tip temperatures becomes a critical factor.

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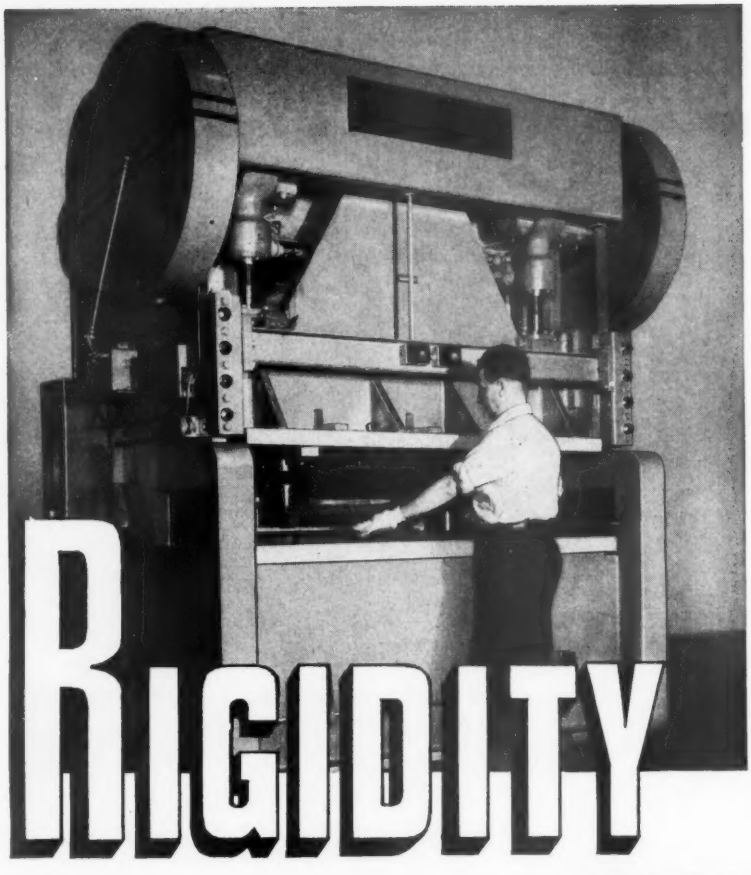

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book review

DIAMOND TECHNOLOGY
by
Paul Grodzinski, A. M. I. Mech. E.

Second revised and enlarged Edition
Published by
N. A. G. Press Ltd., London, W. 6

Available in the United States from
Huebner Publications, Inc.
1975 Lee Road
Cleveland 18, Ohio
Price: $10.00, postpaid.

"Diamond Technology" is a most comprehensive treatment of diamond-working history, techniques and applications. Its authority and accuracy is disclosed by mention of the author and his background..

Paul Grodzinski, a graduate of Technische Hochshule, Dresden, has been head of the Industrial Diamond Information Bureau, a part of the Research Organization of Industrial Distributors, Ltd., since 1943, carrying out the research work for the African Diamond Producers' Association. He also serves as consultant and technical editor, "Industrial Diamond Review." He is also the editor of "Bibliography of Industrial Diamond Applications" incorporated in "Industrial Diamond Review," and is actively engaged in researches in hardness and wear testing of hard materials including diamond.

"Diamond Technology" is a completely revised and enlarged version of Mr. Grodzinski's first English publication, "Diamond and Gemstone Production Methods." It treats to a large extent the traditions of craftsmanship, but includes full information on all modern discoveries and techniques that have been applied.

The book is an essential to all who work with the diamond as an industrial tool. It presents thorough coverage of such vital topics as the production, use and reclamation of diamond powder; manufacture of diamond and sintered carbide dies; the selection and orientation of diamonds; setting diamonds in tools; manufacture of watch and instrument jewel bearings; diamond grinding and lapping of carbides; to mention but a few.

"Diamond Technology" is recognized as the only standard work on the subject and the only book of its kind in technical literature. Over 700 pages, with 486 illustrations and 94 tables.

For Your Future
BUY U. S. SAVINGS BONDS

First Steps from Page 97

in pitch diameter of a gear can be shown as it goes through the heat-treating cycle. The examples just mentioned are but a few of the many cases where statistical data can be used in pin-pointing trouble. It is only logical that the prime requisite of any trouble-shooting scheme is to find the place and cause of the trouble in order that corrective action can be taken. Statistical data is one of the important tools necessary to attain this.

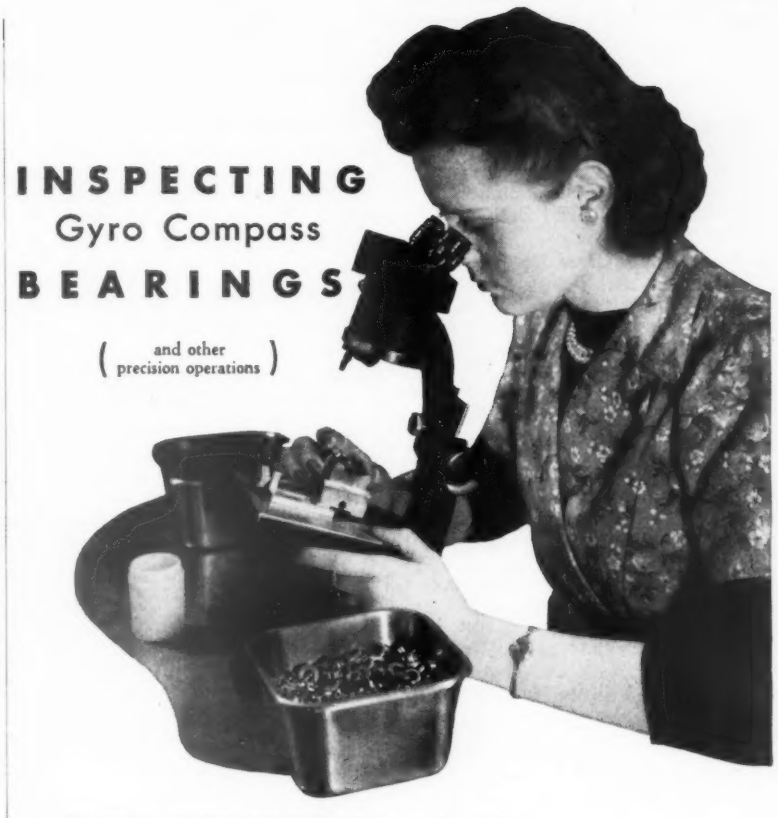
The brief resumes of these five topics are all good selling points in showing top management how Statistical Quality Control can fit into the manufacturing operation. Once management is at least partially sold, the job of organizing, planning, and setting-up the program is undertaken. The important thing to remember at this point is to get started but to not go too fast. By getting started means the running of a few "p" charts or other types of charts for the sole purpose of supplying management with some statistical data. Outside of these few charts for management, no charts should be attempted until a plan for obtaining, recording, and interpreting data has been established. Unless an organized planned procedure is followed valuable time and effort can be wasted on small trivial matters while the important major items are being overlooked. What then is the logical sequence for the proper installment of the program? The importance of selling management has already been emphasized.

The next two steps in order would be (a) getting established and (b) selling the shop. Let us analyze each of these two steps in turn.

The phrase "getting established" is used here to include methods of obtaining data, recording data, type of charts and sampling plans to be used, where to use the charts, finding the troublesome spots (i.e., where the most scrap and rework is made), which departments are the most cooperative, types of reports to be made and sent to keymen in th organization, and the action to be taken from the interpretation of the charts.

By "selling the shop" simply means getting the shop person-

. . . Continued on page 112



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BUFFALO 15, NEW YORK

American Optical Company — Dept. X-179
Instrument Division
Buffalo 15, New York

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Keep Informed • CATALOGS BULLETINS • SPECIFICATIONS

PUBLICATION

This month: Featuring Literature on QUALITY CONTROL Products

Industrial Magnifiers. A "tell-all" handbook and catalog on how to choose and use industrial magnifiers is being offered by the Bausch & Lomb Optical Co., 50421 Bausch St., Rochester 2, N. Y.

Circle Inform-A-Gram No. B1.

Contract Service for all types of precision grinding work is described in catalog currently available from the Acme Industrial Co., 206 N. Laflin St., Chicago 7, Ill. Also quick and super-accurate flat lapping.

Circle Inform-A-Gram No. B2.

Precision Vernier Height Gage. Graduated on 0.001" on both sides, this height gage can be used either on the left or right side of the work. It is available in 12", 18", 24" and 36" measuring capacity. A catalog further explaining the gage is being offered by the Brand Tool & Supply Co., 907 South Victory Blvd., Burbank, Calif.

Circle Inform-A-Gram No. B3.

Electronic Gaging Equipment. Among the **QUALITY CONTROL** equipment presented in this booklet by Brown & Sharpe Procidence 1, R. I., are the external comparator, internal comparator attachment and gage head cartridge. The advantages of these instruments are discussed in full and the gages are well-illustrated.

Circle Inform-A-Gram No. B4.

Micro-Finishing Abrasive Belt. The tool cutting life and efficiency is extended when the cutting edge is micro-finished. This abrasive method is fully described and illustrated in a recent folder put out by Behr-Manning, Troy, N. Y. Also explained is the firm's new Micro Finisher and the Micro-Finishing Durite paper especially designed for grinding carbide tools.

Circle Inform-A-Gram No. B5.

Measuring Surface Quality. There is now a versatile new gage that simplifies the measurement of surface roughness. Read all about this practical shop tool, called the Surfindicator, in the latest illustrated catalog put out by the Brush Electronics Co., 3405 Perkins Ave., Cleveland 14, Ohio.

Circle Inform-A-Gram No. B6.

Standard Optical Comparator Charts that are available for any make and model of projector are subject of new catalog from Gage Co., Battle Creek, Michigan. Thread form and inspection charts, radius and angular layouts.

Circle Inform-A-Gram No. B7.

Optical Gaging. Eastman Kodek Co., Rochester 4, N. Y., has a booklet on its contour projectors with a wealth of information on optical gaging. With a projector the company claims inspection of parts can be done by inexperienced persons in less time than with mechanical gages. The booklet fully describes the workings and applications of contour projectors.

Circle Inform-A-Gram No. B8.

Grating Spectrographs. A new 16-page catalog, which illustrates and describes in detail the JAco line of grating spectrographs, is now available from the Jaerell-Ash Co., Newtonville, Mass. Included in the publication is technical information, data on accessory equipment and a section on the production of the diffraction gratings, suggested spectrographic laboratory layouts and a description of other JAco products.

Circle Inform-A-Gram No. B9.

The new R50 has built-in chip clearance. Designed primarily for wet-cutting of metal bar stock, this new Norton rubber bonded cut-off wheel handles diameters up to 2½" on chopper machines and up to 6" on oscillating machines. Built-in chip clearance, unusual in this type of wheel, is one of the reasons why the R50 cuts freer and cooler, without case hardening the ends of the stock, as for example, stainless steel.

The B2 is versatile. Handy as a general purpose cut-off wheel for the tool room, the Norton resinoid bonded B2 is also used for lighter jobs on plastics, marble, carbon, brake lining and other non-metals.

The R30 is standard. The bond used in the Norton R30 is the standard rubber bond for smaller wheels and is preferred for jobs such as cutting-off thin tubing, small diameter work and fine slotting.

The BN covers a wide job-range. You can't beat the long popular Norton BN wheel for general, all-around usefulness. Or for safety either, because the strong reinforcement of this resinoid bonded wheel practically eliminates breakage from the cutting-off picture. Uses include: notching, slotting and cutting-off gates and risers from non-ferrous castings; cutting wire rope; slotting railway track welds; tuck pointing; cutting non-metallic materials such as fibre board, concrete, tile, plastics, and the like.

The R20 is rugged. A very durable wheel, the Norton R20 has the strongest of rubber bonds. An ideal wheel for dry-cutting of metal rods and other jobs where dressing action is particularly severe.

W—1521

PREVIEWS

Circle postage-free Inform-A-Gram Key Number for your request

Pages 102 through 105 Devoted Exclusively to Information on QUALITY CONTROL

Precision Measuring Tools. An up to date catalog listing all tools, instruments and accessories made by Tesa of Switzerland is now available from the Precision Instrument and Tool Corp., 1775 Broadway, New York 19, N. Y. In this booklet, you are introduced to measuring instruments of the highest precision. It contains full descriptions and in many cases illustrations, technical data and dimensions.

Circle Inform-A-Gram No. B10.

Hydrostatic Testing Machines are the subject of a newly printed bulletin published by Steel City Testing Machines, Inc., 8817 Lyndon Ave., Detroit 21, Mich. Illustrated and described are 3 typical machines, designed and built by the company for hydrostatic testing on a production line basis. Included are units for testing two different types of tubes and an ordnance shell.

Circle Inform-A-Gram No. B11.

The new B9 is as fast-cutting as they make 'em. Adaptable to speeds up to 16,000 surface feet per minute, the new Norton B9 cut-off wheel is a real production booster. Resinoid bonded and available with either regular sides, or with the rougher "F" sides for greater chip clearance, it's a cool-cutting, non-burning performer on all types of metals.

Add the "TOUCH of GOLD" to all your cut-off jobs

Whether your cutting-off jobs involve ferrous or non-ferrous metals or non-metals . . . whether your machines are high speed, low speed or portable . . . remember:

With the right Norton cut-off wheel you're sure of the fast, safe, clean-cutting performance that adds the profit-boosting "Touch of Gold" to every job.

Norton cut-off wheels are made with resinoid, rubber and shellac bonds, in ALUNDUM* abrasive and CRYSTOLON* abrasive, and in all sizes. Count on them for the easy handling and exceptional breakage-resistance that mean happier operators and higher production.

See your Norton distributor, or write to NORTON COMPANY, Worcester 6, Mass. Distributors in all principal cities, listed in your classified phone directory. *Export:* Norton Behr-Manning Overseas Incorporated, Worcester 6, Mass.

NORTON ABRASIVES

Making better products... to make other products better

*Trade-Marks Reg. U. S. Pat. Off. and Foreign Countries

New Dail Bore Gages are covered in catalog DBM from Nilsson Gage Co., Inc., Poughkeepsie, New York. Offers the possibility of perfect visual control right at the machine. Size range covers .090" bore to 48" bore dimensions.

Circle Inform-A-Gram No. B12.

Profusely Illustrated Bulletin #46 covers the Comtorplug internal gage. Use instructions, features, data on prices, sizes and parts. The Comtor Co., 182 Farwell St., Waltham 54, Mass.

Circle Inform-A-Gram No. B13.

Saving Time and Materials in such applications as checking hole sizes and locations, finding centers and gaging slots is simple with precision taper pin gages by Horberg Gage Co., 29 Stables St., Bridgeport, Conn. Kits and complete size ranges. Literature available.

Circle Inform-A-Gram No. B14.

Gaging Cartridges. A 24-page booklet, illustrating and describing a great variety of applications of "Plunjet" gaging cartridges, has been published by the Sheffield Corp., Dayton 1, Ohio. "Plunjet" gaging can be applied to a wide range of gaging, tooling and fixturing devices including inaccessible locations, and also to machine controls.

Circle Inform-A-Gram No. B15.

Industrial Radiography. Here is a technical guide to industrial radiography graciously being offered by the Keleket X-ray Corp., 264 W. 4th St., Covington, Ky. The booklet is a compact, understandable exposition of the elements of industrial radiography. It is designed to meet the needs of the metallurgist, **QUALITY CONTROL** engineer and department heads.

Circle Inform-A-Gram No. B16.

Indicator Catalog from Tubular Micrometer Co., Box 30, St. James, Minn., has data on a complete line of dial indicators. Entire line has high-visibility reading for speed and accuracy. Very complete.

Circle Inform-A-Gram No. B17.

Plastic Gage Handles One Third Lighter than aluminum, tough, long-lasting and that will not chip or mar are described in literature now available from Federal Tool Corp., 3603 W. Pratt Blvd., Chicago 45, Ill. Possess good insulating qualities and come in four colors for ready identification.

Circle Inform-A-Gram No. B18.

Koch Test Indicator for precision work is the subject of a recent mailing piece from Andrew Genales, 28 Second Ave., Nyack, New York. Gives all features, specifications attachments, etc.

Circle Inform-A-Gram No. B19.

Carb-O-Plated Gages. These gages are made with a steel base and a thin wear-resistant coating of hard tungsten carbide. Some typical uses of the gages, as well as properties of the carbide coating as applied by the Linde Process, are contained in literature available from Lincoln Park Industries, Inc., 1719 Ferris Ave., Lincoln Park 25, Mich.

Circle Inform-A-Gram No. B20.

Industrial X-ray. From one of the oldest names in X-ray comes the latest in the complete line of industrial equipment. It's all described in a new bulletin, yours for the asking. Write to Keleket X-ray Corp., 264 W. 4th St., Covington, Ky.

Circle Inform-A-Gram No. B21.

Bases & Surface Plates. Here is a pictorial review of how base and surface plates, made by the Lake Shore Engineering Co., Iron Mountain, Mich., are used. The photos show the wide spread applications the base and surface plates have in the automotive industry.

Circle Inform-A-Gram No. B22.

To Protect Their Ships From Unseen Dangers . . .

Mariners Use Marking Devices

Guiding his ship through shoal, narrow or treacherous waters, the Mariner depends on channel buoys, lighthouses, flashing lights, and other marking devices—all directing him to his safe course through navigable water.

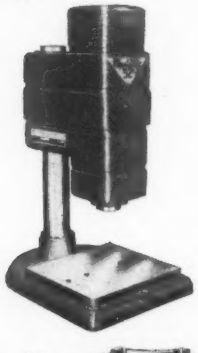
CADILLAC 52

Air Impact Press

For

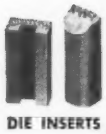
High Speed Marking—

Assembling, Branding, Staking, Crimping, Riveting and also for producing Light Stampings



This new Cadillac "52" is faster, has more power, more pressure. It delivers in speeds up to 10,000 strokes per hour — pressure can be obtained up to 8 tons, and is adjustable from light to heavy marking. The pressure can also be regulated to give proper ram action for branding or color leaf marking. Special jigs or fixtures are not required for average work. The Cadillac "52" has automatic controls which "think" for the operator — give high production. Can be supplied as: Hand actuated, foot actuated, electrically actuated. It is light in weight, can be easily moved.

For full information write for Bulletin A-52



DIE INSERTS

ROLL SEGMENT DIES

FORGING HAND STAMPS

Many marking problems can be solved by Cadillac Marking Devices such as these . . . all made of special alloy tool steel, giving long life and unexcelled performance.

For full information write for Bulletin SE-130

CADILLAC STAMP CO.

FACTORY and OFFICES

17303 RYAN ROAD • DETROIT 12, MICH.

Snap Gage. The Vinco dial indicator snap gage is easily converted from use on splines and gears to plain diameters. It is available in 11 standard sizes for major diameters ranging from 3/16" up to and including 5 inch. This jeweled, cushioned movement dial indicator is graduated in increments of 0.0001 inch. A brochure, describing the gage and illustrating how it is used, is being offered by the Vinco Corp., 9111 Schaefer Highway, Detroit 28, Mich.

Circle Inform-A-Gram No. B23.

Honing of all Parts from ½" to 2½" OD can be done on any drill press, lathe, or electric drill using a single tool. Write for literature on the "Odee-Hone" to the Micromatic Hone Corp., 8100 Schoolcraft, Detroit 4, Michigan.

Circle Inform-A-Gram No. B24.

Vernier Height Gages, Calipers, Depth Gages, thread, ring, and snap gages represent just a few selections from the enormous stock of the Sid Tool Co., Inc., 126 Lafayette St., New York 13, N. Y. Mailing list now open for new names.

Circle Inform-A-Gram No. B25.

Sharp Image Definition with glare-free accuracy is feature of "Century" optical comparator. Illustrated circular describes features and operation. From Portman Instrument Co., 6 Manhasset Ave., Port Washington, N. Y.

Circle Inform-A-Gram No. B26.

Hardness Tester. Precision Hardness testing is a "must" in modern manufacture reports Clark Instrument, Inc., 10200 Ford Rd., Dearborn, Mich. And for hardness testing, the firm has available a 20-page manual fully describing its line of instruments and their uses.

Circle Inform-A-Gram No. B27.

Instant Accuracy for any angular set-up, whether single or compound, is provided for by the use of the "Magna-Sine" from the Omer E. Robbins Co., 5722 12th St., Detroit 8. A curent catalog is available to T & P readers from the maker.

Circle Inform-A-Gram No. B28.

Testing Equipment. Here we have a well-illustrated brochure describing the features of the Baldwin-Emery SR-4 Testing Machine, (Model FGT) and its accessories. This machine can be used for static, dynamic and impact testing of materials and also can serve as a loading frame for strain gage and brittle lacquer experimental stress analysis of parts, components and structures. Write to Baldwin-Lima-Hamilton Corp., Testing Equipment Dept., Philadelphia 42, Pa.

Circle Inform-A-Gram No. B29.

Hardness Testing on all Types of Work is made possible with the "Scleroscope" by Shore Instrument Mfg. Co., Inc., 9025 Van Wyck Ave., Jamaica 2, New York. Literature covers all models fully.

Circle Inform-A-Gram No. B30.

Low Cost Precision is available in the "Tuna" vernier caliper from Swedish Gage Co. of America, 8900 Alpine Ave., Detroit 4, Michigan. Best Swedish steel, hardened measuring surfaces. Full specifications from maker.

Circle Inform-A-Gram No. B31.

Optometer Measuring Microscope. This precision measuring instrument is designed for on-the-spot inspection in the shop, in the laboratory or in the field. An engraved scale in the body tube reads directly to 0.002". The measuring microscope is a product of the National Instrument Co., 5005 Greensbury Ave., Baltimore 15, Md. Literature is available upon request.

Circle Inform-A-Gram No. B32.

Gaging Equipment. New, complete descriptive bulletins on the Indi-Ac electronic indicator, Par-Ac electronic gage and Micro-Ac electronic micro-comparator are now available from the Cleveland Instrument Co., 735 Carnegie Ave., Cleveland 15, Ohio. The bulletins define the fields of application of each instrument, show the equipment in use and describe each unit. Controls and adjustments are identified; meter scales are shown and actual sizes and detailed specifications are included.

Circle Inform-A-Gram No. B33.

Precision Lapping. This operation by the centerless method is a simple and accurate procedure. Size Control Company's centerless lapping machines are used for lapping of oversize gages; lapping worn gage plugs to next lowest size and for lapping bearings, bushings, shafts or contoured pieces. Size Control Co., 2500 W. Washington Blvd., Chicago 12, Ill., has a brochure now available that gives detailed information on the production economies of centerless lapping as well as machine specifications and operating procedures.

Circle Inform-A-Gram No. B34.

X-ray Production-QUALITY Control. A new 6-page folder titled "X-ray Analysis—Three Way Tool of Industry" is available from the Research & Control Div., North American Philips Co. Inc., 750 S. Fulton Ave., Mt. Vernon, N. Y. Text gives full explanation of the procedure used in production control and in laboratory applications in order that film-type diffraction, X-ray Diffractometer and X-ray Spectograph techniques may be clearly understood.

Circle Inform-A-Gram No. B35.

Production Speeding Measuring Equipment is graphically portrayed in a new catalog sheet from the O-Vee Gauge Co., 2516 West Vernon Ave., Los Angeles 8, Calif. Screw thread comparators and gages are featured.

Circle Inform-A-Gram No. B36.

The Reich 3-Way Surface Test Indicator can be read by viewing from either side or at the end, has scale graduated in thousandths with a non-magnetic movement range of .014". Feeler may be set at any position from 90° of its vertical position. J. R. Reich Mfg. Co., 45 E. Stroop Rd., Dayton 9, Ohio.

Circle Inform-A-Gram No. B37.

Current Gage Catalog from Perfex Gage & Tool Co., 123 Avery, Mt. Clemens, Mich., gives tabulated prices for size range of reversible thread gages, thread plug and ring gages, and cylindrical plug gages.

Circle Inform-A-Gram No. B38.

Micrometer. Karl A. Neise Co., 341 Fourth Ave., New York 16, N. Y., is the U. S. representative for the August Steinmeyer Co. Neise is distributing a brochure on the firm's new "Microfix" micrometer which boasts of a window reading that makes it even easy for beginners to read a mike with ease.

Circle Inform-A-Gram No. B39.

NEW

CARBIDE TOOL FINISHING METHOD

Hammond CARBIDE BELT FINISHER

NOW — it is possible to final-finish single-point carbide tools

Without diamond wheels
Without highly skilled operators

Here is a NEW METHOD AND NEW MACHINE which have been proved in actual production. The Hammond Model 454 Carbide Belt Finisher is for final finishing with an abrasive belt after rough grinding with a silicon carbide wheel. It features —

Model 454
Carbide Belt Finisher

TUNGSTEN CARBIDE FACED PLATEN

Permits finishing the end, top and side clearance angles of single point tools.

CONVENTIONAL TABLE

Nothing new for operators to learn. One setting for all size tools.

LOW COST INITIAL INVESTMENT

Using abrasive belts in place of diamond wheels means a low cost initial investment. Also *eliminates the risk of substantial loss due to damage to diamond wheels.*

"Seeing is Believing" "Clip" this ad to your letterhead. We will arrange for you to use one. No obligation.

Hammond Machinery Builders INC

1631 DOUGLAS AVENUE KALAMAZOO, MICHIGAN

See us at Booth 1150 — National Metal Exposition

Electro Valve. Sciaky Bros., 4915 W. 67th St., Chicago, Ill., has a bulletin covering its 4-way type electro valve for accurate, dependable remote control of air operated, mechanical devices.

Circle Inform-A-Gram No. B40.

Milling Machines. The various features of the Hercules No. 2 plain, universal and vertical milling machines are the subject of a brochure recently put out by the Parker Machine Co., 158 Pioneer St., Brooklyn 31, N. Y. Illustrations and specifications included in this detailed catalog.

Circle Inform-A-Gram No. B41.

Diamond Wheels. This illustrated catalog on diamond wheel shapes and sizes is available by writing for Catalog No. 850 to United States Diamond Wheel Co., Dept. N, 835 Illinois Ave., Aurora, Ill.

Circle Inform-A-Gram No. B42.

Resistance Welding. This booklet presents an interesting example of electric resistance welding to rigid government and aircraft specifications for external fuel tanks. Several interesting techniques for seam welding are also described in the booklet. It is available from Sciaky Bros., 4915 W. 67th St., Chicago, Ill.

Circle Inform-A-Gram No. B43.

Check Nut
This is a VLIER Torque Thumb Screw
A trouble-free holding tool that properly supports work pieces against machine tool pressures and automatically prevents their distortion due to overtightening. This assures you of precision machining of even fragile parts.
It Works Like This...
The free-rotating head contains a ball check that works against accurately controlled spring pressures. Upon arriving at the pre-determined holding pressure, the head rotates freely and prevents overtightening of the screw. "Tight is tight enough!"
And These Are the Mechanical Details
Body thread is National Coarse Series Class No. 1 fit. Check nut provided on most sizes prevents backing off under chatter. Holding pressures range from 0-50 lbs. Accuracy and uniformity guaranteed. Made of hardened and rust-proof selected steels. Nothing to wear or break.
Available in Four Types
1. Regular—Type A—for normal supporting.
2. Inverted—Type B—Reverse of Type A support.
3. Tee Head—Type C—used with sliding V-Blocks.
4. Adjustable—Type D—set your own holding pressures.
There is a nearby Vlier distributor to serve you. Write today for complete catalog which includes Spring Plungers, Spring Stops, Fixture Keys and Toggle Pads.
VLIER
VLIER MANUFACTURING COMPANY
Manufacturers of
Toggle Pads, Spring Plungers, Spring Stops, Fixture Keys
4552 Beverly Boulevard, Los Angeles 4, California

Threading Tools. Here is a catalog that covers the complete line of collapsible taps and self-opening die heads made by the Murchey Division of the Sheffield Corp., Dayton 1, Ohio.

Circle Inform-A-Gram No. B44.

Induction Heating. Sixty cycle induction heating by the Loftus Thermo-Induction process is explained in a recent brochure now being distributed by the Loftus Engineering Corp., 610 Smithfield St., Pittsburgh 22, Pa. This new process, as explained in the booklet, is said to assure full penetration in mass heating.

Circle Inform-A-Gram No. B45.

Production Engineering. This 4-page bulletin gives a practical definition of how products are adapted to production engineering techniques which include design analysis, production processing, process specification and work simplification. Write Designers for Industry, Inc., 2915 Detroit Ave., Cleveland 13, Ohio.

Circle Inform-A-Gram No. B46.

Interchangeable Punches and Dies. New products have been added in the revised edition of the general catalog on interchangeable punches and dies put out by the Richard Brothers Division of Allied Products Corp., 1560 E. Milwaukee Ave., Detroit 11, Mich. New items appearing are clinch nut punches and dies and heavy duty punches and retainers. Standard stock sizes have been revised for square punches and oblong and square die buttons.

Circle Inform-A-Gram No. B47.

Jig Borers. Two recent catalogs describe the new Moore Models 1 and 2 precision jig borers. Moore 1 can locate holes within 0.0001" and is best suited for toolrooms and jobbing shops making tools and dies for moderate size parts. Model 2 has increased capacity and size, capable of taking heavier cuts and boring larger holes up to 7" in mild steel or cast-iron. Write to Moore Special Tool Co., 740 Union Ave., Bridgeport 7, Conn.

Circle Inform-A-Gram No. B48.

Molden Nylon. This material is rapidly developing into an engineering material with wide-spread application as a component in all types of industrial and consumer units. For providing a "rule-of-thumb" method of determining the use of nylon, Nylon Molded Products Corp., Garrettsville, Ohio has prepared a technical bulletin which provides a simple procedure for figuring material cost of a nylon part, with an accompanying chart on the areas of circles for easy calculation of volumes.

Circle Inform-A-Gram No. B49.

"Get A Better Grip on Production" is the title of a new brochure on Levermatic and Handmatic spindle nose collet chucks made by the Sutton Tool Co., Sturgis, Mich. Included in the circular is data on special and standard applications of the chucks plus specifications.

Circle Inform-A-Gram No. B50.

Materials Handling Methods with Heppenstall Tongs and "C" Hooks are illustrated and described in a new 24-page brochure published by Heppenstall Co., 4620 Hatfield St., Pittsburgh 1, Pa. Shown for the first time are suction tongs for lifting flat, smooth objects and spacer tongs for lifting the convection spacers used in a number of rolling mills. In addition, the brochure illustrates two types of motorized tongs.

Circle Inform-A-Gram No. B51.

The Commander Adjustable Multi-Drill that drills up to 8 holes in 1 stroke is one of several products made by the Commander Mfg. Co., 4225 W. Kinzie St., Chicago 24, Ill., described in detail in the firm's latest bulletin. Other tools treated are the Commander Tapper ("the Tapper that thinks for the operator"), drill chip breakers and the Commander precision drilling coolant table.

Circle Inform-A-Gram No. B52.

Tru-Tork Dynamometers with self-regulating brakes are pictured and explained in Technical Bulletin No. 550 prepared by the George Nankervis Co., 19255 W. Davison Ave., Detroit 23, Mich. The dynamometers for testing AC and DC electric motors, read directly in foot pounds and in horsepower without conversions or formulas.

Circle Inform-A-Gram No. B53.

Literature on a New Dielectric Sealer is available on request from the Adhesives and Coatings Div. of the Minnesota Mining and Mfg. Co., 423 Piquette Ave., Detroit 2, Mich. This sealing compound is designed to protect electrical wiring connections from excessive shrinkage, water and high moisture concentration.

Circle Inform-A-Gram No. B54.

Research and Development, a 4-page folder, calls attention to the need for careful direction and scheduling of research in the mechanical, hydraulic, electro-mechanical and electronic engineering fields. A description of the services offered in development engineering projects is included with the steps undertaken in a typical research and development program. Write to Designers for Industry, Inc., P. R. Department, 2915 Detroit Ave., Cleveland 13, Ohio.

Circle Inform-A-Gram No. B55.

Machine Tools. Heinrich Tools, Inc. is now distributing its latest tool catalog on drill press vises, fixture locks, nibblers, punches and rod cutters. Write to Heinrich Tools, Inc., Dept. 133-J, Racine, Wis.

Circle Inform-A-Gram No. B56.

Brass Rod Mill Depots. A new 4-page folder issued by Titan Metal Mfg. Co., describes the firm's depot facilities for quickly supplying brass rods; fabricated parts and other brass products to users. A map is included showing location of all Titan depots, offices and agencies and cities in which Titan rod is warehoused and distributed throughout the U. S.

Circle Inform-A-Gram No. B57.

Coolant Pumps. Graymills coolant pumps are available for all machine tools. The firm's catalog not only describes these units in full but offers an easy-to-use selection chart. The address is Graymills Corp., 3705 Lincoln Ave., Chicago 13, Ill.

Circle Inform-A-Gram No. B58.

Carbide Threading Tool. Included in the line of Standard Carbide Tipped Tools produced by Super Tool Co., 21650 Hoover Rd., Detroit 13, Mich., is an off-center threading tool. Circular No. 531 completely details this off-center tool plus the Super line of turning, facing, boring and threading tools.

Circle Inform-A-Gram No. B59.

All Standard Accessories
Ready to Go Immediately
DETROIT DIE SET CORPORATION immediately on receipt of order ships all standard items in a wide range of sizes . . . dowel pins, die springs, stripper bolts, socket grip head cap screws and other accessories. All are nationally known products manufactured with the same precision as "DETROIT" die sets. For dependable shipment, 'phone, wire or write "DETROIT."
CALL "DETROIT"
DETROIT TR 2-5150
BIRMINGHAM, ALA. 3-1341
BUFFALO CI 0163
CHICAGO PU 5-7694
CINCINNATI HU 7775
CLEVELAND TO 1-0860
DALLAS TE 3818
DAYTON HE 3042
INDIANAPOLIS HU 5604
LOS ANGELES AD 7251
MILWAUKEE GL 3-7470
MINNEAPOLIS PR 1822
MONTREAL, CAN. WI 1186
NASHVILLE 6-2597
NEWARK MA 2-4318
ORLANDO, FLA. 2-3747
PHILADELPHIA VI 4-4084
PITTSBURGH LO 1-4011
ROCK ISLAND, ILL. RI 8-2814
ST. LOUIS FR 6811
SEATTLE SE 7997
TOLEDO MA 4510
TORONTO, CAN. KE 2972
DETROIT DIE SET CORPORATION
2895 W. GRAND BLVD. • DETROIT 2, MICH.
DETROIT DIE SET ★

A Special Condensed Price List and catalog, which includes details on all new price adjustments and specifications of its standard cemented carbide tools and blanks, has just been released by the Carboloy Dept. of the General Electric Co., 111 E. 8 Mile Rd., Detroit 32, Mich.

Circle Inform-A-Gram No. B60.

Solid Triangular Tool Bits of carbide, HSS, tantung or stellite can be adapted to special multi-stage boring bars by inserting a new quill that is explained fully in a bulletin made available by the Everede Tool Company, 2000 N. Parkside Ave., Chicago 39, Illinois.

Circle Inform-A-Gram No. B61.

Portable Elevating Table. This "Portelevator" makes it easier to lift, lower, level, and transport loads up to 5,000 pounds. Get the details from the Hamilton Tool Co., 832 S. 9th St., Hamilton, Ohio. Ask for Bulletin P-5247.

Circle Inform-A-Gram No. B62.

The Rivett Model No. 1020, 12" Swing Precision Toolroom Lathe is illustrated and described in a new 18-page catalog published by Rivett Lathe & Grinder, Inc., Brighton 35, Boston, Mass. Featured in the new catalog is the lathe's double-duty design and the "Steelway" bed.

Circle Inform-A-Gram No. B63.

JOHNSON BAND SAWS

SPECIFICATIONS
MODEL B

Capacity—5" rounds, 10" flats.
Height Overall—(Closed)—32".
Blade Length—7'5" x ½" x 23 ga.
Floor Space—46" x 28".
Weight—(Uncrated) 235 lbs. Crated 280 lbs. Boxed for Export 400 lbs.
Wheel Diameters—10".
Motor—⅓ H.P. any voltage available.
Speeds—45, 90 and 150 ft. per min.
Casters—Optional at slight extra cost.

MODEL J, 10" x 18" CAPACITY ALSO AVAILABLE
WRITE FOR DETAILS

JOHNSON MANUFACTURING CORP.
ALBION, MICHIGAN

A Washer and Metal Stamping catalog has been made available by the Quadriga Mfg. Co., Dept. T12, 213 W. Grand Ave., Chicago 10, Ill. This free booklet contains useful information on tension, friction and finishing washers; wire terminals; blanking dies, dished blanks, standard gages; progressive and compound dies.

Circle Inform-A-Gram No. B64.

Eclipse Gas-Fired Crucible Furnaces for melting non-ferrous metals are given careful treatment in Catalog No. C-2 recently published by the Eclipse Fuel Engineering Co., Rockford, Ill. Factors such as heat input, type of refractory, structural framework and atmosphere and temperature control are elaborated upon in this booklet.

Circle Inform-A-Gram No. B65.

High Pressure Cylinders for Hydraulic Operation are described in detail in a new illustrated booklet offered by the Hanna Engineering Works, 1765 Elston Ave., Chicago 22, Ill. Featured in the booklet is information on high pressure capacities, velocity of pistons and data on the construction of a high pressure hydraulic cylinder.

Circle Inform-A-Gram No. B66.

Combination Motor Starters are described in detail and are copiously illustrated with photos of the various types available in Bulletin 514-515 issued by the Industrial Controls Division of Federal Electric Products Co., 1429 Park St., Hartford 6, Conn. Detail drawings of special features, plus dimensions and weights of all types of starters are included.

Circle Inform-A-Gram No. B67.

The Wales Sheet Metal Fabricator for punching, notching and nibbling up to 165 strokes a minute is fully described and illustrated in Catalog 10-AA (1st Edition) just off the presses. Outstanding features pointed out in the publication are rapid interchangeability of tools and speedy accurate setup. The catalog is available from Wales-Strippit Corp., 345 Payne Ave., N. Tonawanda, N. Y.

Circle Inform-A-Gram No. B68.

Hydraulic Fluid Line Tubing. A new 4-page bulletin just published by Joseph T. Ryerson & Son, Inc., Box 8000-A, Chicago 80, Ill. The booklet contains Joint Industries Conference recommended practice for industrial equipment, analysis and description of cold drawn seamless steel hydraulic tubing that meets these standards. Also included, is a table of sizes and calculated bursting pressures of steel hydraulic tubing available for shipment from stock.

Circle Inform-A-Gram No. B69.

A "Desegatized" High Speed Steel. EUB-4 is an extremely high carbon, high vanadium, tungsten base super high speed steel. It can be operated at extremely high cutting speeds and is especially applicable for single point cutting tools, form tools, hobs and inserted blade cutting tools for machining austenitic alloys, scaled and sandy castings and heat treated sections. Recommendations for working EUB-4 plus hardening and tempering data are contained in a 4-page brochure available from the Latrobe Steel Co., Latrobe, Pa.

Circle Inform-A-Gram No. B70.

Hole Punching Units. The new Wales Type "H" Horizontal hole punching units are designed to punch holes in curved and straight flanges, rims and angles and similar shaped and formed work. Punching holes in the side of the work instead of on top of flat surfaces is made possible by designing these units so the punches move back and forth horizontally rather than up and down. For complete information write to Wales-Strippit Corp., 345 Payne Ave., North Tonowanda, N. Y., for Catalog H.

Circle Inform-A-Gram No. B71.

New Ductalloy Casting Booklet. American Brake Shoe Co., 230 Park Ave., New York, N. Y. has issued a new 12-page booklet on industrial casting of Ductalloy (their trade name for ductile iron). Properties, characteristics and applications are described for three standard grades of Ductalloy produced by two divisions of the company. Pictured are typical castings for use in aviation, chemical, diesel and general industrial fields.

Circle Inform-A-Gram No. B72.

Industrial Castings. Mechanite castings for industry are described in a new 8-page folder published by the American Brake Shoe Co., 230 Park Ave., New York 17, N. Y. The booklet describes characteristics of the material, lists properties and carries engineering data on hardenability, section strength and comparative properties of other cast metals. Typical applications are pictured and a table of standard bar stock is included.

Circle Inform-A-Gram No. B73.

Time Delay Unit. The Agaswitch, for introducing a manually or mechanically initiated adjustable time delay into an electrical circuit, is described in Bulletin SW-2, which is available from the A'G'A Division, Elastic Stop Nut Corp. of America, 1027 Newark Ave., Elizabeth, N. J. Included in the circular is mounting, electrical and application data, plus wiring diagrams.

Circle Inform-A-Gram No. B74.

Die Maker. A complete catalog of information on the services and facilities offered by a maker of precision dies is now being offered. The booklet is available from the Harig Mfg. Co., 5761 W. Howard St., Chicago 31, Ill.

Circle Inform-A-Gram No. B75.

Alloy Centers. Literature from the Gorham Tool Co., 14415 Woodrow Wilson, Detroit 3, Mich., gives descriptions and dimensions on alloy centers with a "deep core design." The deep core is induction brazed deep in the shank and was expressly designed for wear, abrasion and heat resistance.

Circle Inform-A-Gram No. B76.

Jig & Fixture Parts. Among the many items described in Jergens Tool Specialty's new folder are blank jaws, tee slot nuts, sine fixture keys and shoulder screws. Write to Jergens Tool Specialty Co., Dept. TP-9, 712 E. 163rd St., Cleveland 10, Ohio.

Circle Inform-A-Gram No. B77.

Boring Tools. Especially designed and engineered to cut machining time to a minimum is the claim the Lehmann Boring Tool Co., 4389 Duncan Ave., St. Louis 10, Mo., makes about its products. They invite you to write for the Lehmann Boring Tool Catalog BT-12.

Circle Inform-A-Gram No. B78.

For All Sheldon Lathes less than 5 Years old...we have just published a new Parts List Manual, with:

. . . . every lathe part and sub-assembly illustrated, named, numbered and positioned on explanatory exploded drawings.

. . . . a section which illustrates and describes each of over 50 modern Attachments and Accessories to make your Sheldon Lathe even more versatile, productive and valuable to you.

To get this valuable Parts List (and Accessory) Manual just write (1) the serial number of your Sheldon Lathe and (2) your name, and (3) your firm name and address, on a post card, letterhead, billhead or slip of paper and mail it to "Parts Manual".

SHELDON MACHINE CO., INC.
4235 North Knox Ave., Chicago 41, Illinois

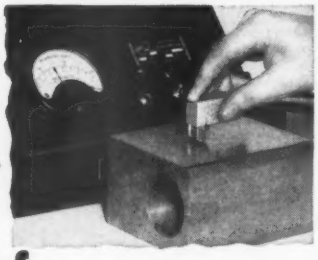
Tool Sharpening. Here is a most informative catalog (Bulletin L22) put out by the Micrometrical Mfg. Co., 345 S. Main St., Ann Arbor 15, finish saves time, tools and materials; why cutting tools often produce a non-consistent finish and how to obtain more consistent finish and more pieces per grind.
Circle Inform-A-Gram No. B79.

Carbide Form Tools. For quick answers on tough cutting problems, a catalog showing examples of Spiral time saving tools is being offered by the Spiral Step Tool Co., Dept. T, 5400 N. Damen Ave., Chicago 25, Ill.
Circle Inform-A-Gram No. B80.

'dag' Dispersions for Industry. A new 4-page booklet, containing a list of 37 dispersions of colloidal graphite, molybdenum disulfide, vermiculite and zinc oxide has been issued by the Acheson Colloids Co., Port Huron, Michigan.
Circle Inform-A-Gram No. B81.

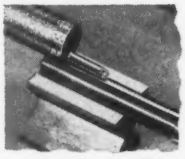
Prescision Casting. Workpiece examples from the great variety of metals, both non-ferrous and ferrous, that can be precision cast by the lost wax method are displayed in a catalog available from the Cadmet Corp., 20801 Ryan Rd., P. O. Box 4631, Detroit 34, Mich.
Circle Inform-A-Gram No. B82.

You can measure

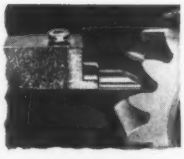


Measuring roughness of a flat surface with manually-operated Profilometer Type MA Tracer. Meter shows average roughness height directly in microinches. Tracer also measures on ID's and OD's.

the roughness of

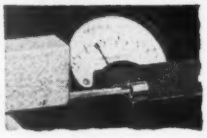


Measuring roughness of narrow spline with Type AW Tracer. Projecting nose of Tracer enters small holes.



Type J Tracer measuring roughness of gear tooth. This Tracer, like others, also measures on ID's, OD's, and flats.

nearly ALL machined and finished surfaces



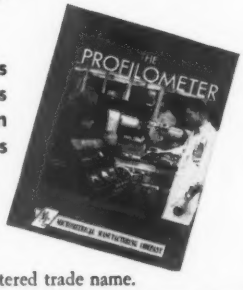
Measuring roughness in 1/16" ID with Type KA Tracer.

Type GB Tracer measuring roughness of recessed groove.

with the PROFILOMETER

. . . thereby saving time and money in unexpected ways

THE PROFILOMETER is a shop tool. It's fast; versatile; easy to use. Shows roughness directly in microinches (millionths of an inch). Small selection of equipment meets most needs.



FREE BULLETIN LT77 gives details — describes production and quality control applications. Want a copy? Write!

Profilometer is a registered trade name.

MMCo
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MANUFACTURING COMPANY
345 S. MAIN ST. • ANN ARBOR 15, MICHIGAN

Jig & Fixture Parts. This new manual published by the Standard Parts Co., 1000 Broadway, Bedford, Ohio, presents a complete line of jig and fixture components. Over 500 tool components, many of which are

new and never before have been presented to the trade, are included in this practical booklet. As a aid and time saver for designers, many of the parts drawings included can be used for direct tracing. Full size tracing templates for other sizes are also available upon request.
Circle Inform-A-Gram No. B83.

Steel Balls. An attractive new leaflet, containing information on Fischer steel balls and their applications has been announced by Frazer & Co., 50 Church St., New York 7, N. Y. Discussed are chrome steel balls, stainless steel balls and sundry balls. Under each listing are the applications for bearings in armatures, valves and pumps, as casters, burnishing balls, gage balls and crushing and grinding balls.
Circle Inform-A-Gram No. B84.

"T" Slot Clamps. Used for holding down work on planers, drill presses, milling machines and other machines having slotted tables, these clamps are fully described in a brochure now available from the Armstrong Bros. Tool Co., 5200-53000 W. Armstrong Ave., Chicago 30, Ill. Catalog also shows Armstrong "T" slot bolts, nuts, washers, strap clamps and jacks and step blocks.
Circle Inform-A-Gram No. B85.

Press Modernization. Forty-two standard modernization and conversion assemblies have been developed by E. W. Bliss Co., Canton, Ohio, to restore full operating efficiency to old presses. Applicable to all Bliss-built presses, the modernization assemblies are described and illustrated in a new booklet just issued. "Before" and "After" views illustrate many of the modern conversion possibilities.
Circle Inform-A-Gram No. B86.

Better Bond for Organic Finishes. This bulletin includes a Phosphating Reference Chart which outlines the purpose of the phosphate coatings. Government specifications met by Turcoating materials, recommended uses, methods of application, etc. Put out by Turco Products, Inc., Terminal Annex 2649, Los Angeles 54, Calif., this pamphlet (A-108) describes the complete line of Turcoating material.

Circle Inform-A-Gram No. B87.

Precision Machine Tools. Here is a condensed general catalog on the many precision machines made by the George Gorton Machine Co., Racine, Wis. Plenty of illustrations, along with specifications and dimensions, help give you an idea of the quality of the firm's milling, profiling, die sinking and engraving machines.

Circle Inform-A-Gram No. B88.

Beryllium Copper. Ways in which beryllium copper can help engineers solve their design problems are illustrated by actual cases in a new booklet, "Applications Unlimited," offered by the Beryllium Corp., Reading, Pa. Among the problem solving qualities illustrated are the ease of fabrication, high strength, good electrical and thermal conductivity, resistance to wear and corrosion and unusual castability.

Circle Inform-A-Gram No. B89.

Adhesives, Coatings & Sealers. Adhesives enjoy wide automotive acceptance because they are versatile in application, effective in holding power, inconspicuous and permit greater flexibility in product styling. To learn more about how automotive adhesives might be used elsewhere write for the well-illustrated and detailed catalog offered by the Minnesota Mining and Mfg. Co., Adhesives and Coating Division, 411 Piquette Ave., Detroit 2, Mich.

Circle Inform-A-Gram No. B90.

Dust Control. How dust can be controlled in metal-working industries is discussed in a bulletin published by American Wheelabrator & Equipment Corp., 1183 S. Byrkit St., Mishawaka, Ind. Particular attention is given to the use of high-efficiency cloth-tube type dust collectors in the ventilation of grinding and annealing operations.

Circle Inform-A-Gram No. B91.

Automatic Flute Grinder. The Wardwell Mfg. Co., 3155 Fulton Rd., Cleveland 9, Ohio, offers a catalog that carries a full description of its 90 FS Automatic Universal Flute Grinder. This machine flutes a variety of special size drills, reamers, spiral or straight milling cutters, end mills and saws in gangs up to 7¾" long.

Circle Inform-A-Gram No. B92.

Blast Cleaning. A new bulletin describing a new blast cleaning and peening abrasive has been published by American Wheelabrator & Equipment Corp., 1183 S. Byrkit St., Mishawaka, Ind.

Circle Inform-A-Gram No. B93.

Sectional Stock Racks. A new folder on sectional arm racks just issued by the Brown Engineering Co., 132 N. Third Street, Reading, Pa., shows how to save storage space and yet retain easy access to a variety of sizes and shapes of bars, rods, strip, tubing and other types of metal working stock.

Circle Inform-A-Gram No. B94.

Cutter Catalog. Important recent advances in tool design have made it necessary for the Ingersoll Milling Co., Rockford, Ill., to revise its catalog on inserted blade milling and boring tools.

Circle Inform-A-Gram No. B95.

Abrasive Grit. This is one of the costliest cutting tools in a plant. It's not a tool of production—but one of destruction. Hammond DusKolectors trap dangerous dust before it can do harm to either employees or tools. Write to Hammond Machinery Builders, 1631 Douglas Ave., Kalamazoo, Mich.

Circle Inform-A-Gram No. B96.

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THE Hallmark OF
Precision Gage Blocks
Now Offers . . .
QUALITY . . . Lasting precision — in millionths
PRICE . . . Traditionally low prices in spite of rising costs
DELIVERY . . . FONDA now ships most orders direct from stock.
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First Steps from Page 101

nel quality minded. The best way this can be brought about is by a complete training program conducted by the statistical quality engineers. All the inspectors, foremen, lead men, and setup men should attend these training sessions which should be held at least one hour a week. Care should be taken in selecting groups for the classes so that all the men from one department are not removed from their duties at the same time. In the beginning, the less interference with normal production, the better results will be for the program. It is during these training periods that the quality control man becomes acquainted with the key men in the shop. He should clearly state the aim of the program and show why the information desired from these men is so important. By careful observance the quality control man can determine which of these key men and what department seems to be the most interested and cooperative.

This then is the clue on where to start the charting program. At the rate of one hour a week classes should continue for two or three months to enable the trainees to master the mechanics of various types of charts and sampling plans. Even though the control limits and process capabilities will be computed by the SQC engineer several examples should be shown to the trainees in order to acquaint them on how their data will be used to control the quality of the material produced.

Once the shop training program is underway the SQC man can begin the task of getting established. The obtaining of data is not as simple as it appears on the surface. Numerous file copies and records must be examined in order to obtain the information desired. An investigation of the office records kept by the various departments in the organization for certain data may save hours and even weeks of burdensome labor to obtain the information desired. After a month or two of combating the battle of paper work, the quality control man automatically begins to invent new schemes to lighten his burden for obtaining the data he needs.

Again it should be stated that the problem of getting established requires time and cannot be obtained overnight. Since it is so very important for the proper advancement of the program, it should be planned diligently and the cooperation from various departments should be strived for constantly. When the proper methods for obtaining data and recording it have been established, the program is ready to bear some fruit.

A report on the production quality level for the last six months is highly recommended at this point. This report should give a picture of the history of the manufacturing in the past stating the percentage of defective material produced, the amount of scrap and rework, which items and even what dimensions seem to cause the greatest amount of scrap and rework. From this type of information a systematic plan for combatting the different types of difficulties can be determined. The report just mentioned plus the observance in the shop training classes on cooperative per-

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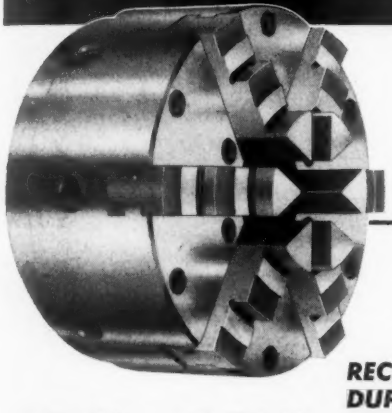

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3-Jaw and 6-Jaw Models Available in 4", 5", 6", 7½", and 9" Diameters. 2-Jaw Aviation Chucks Also Available in 6", 7½", and 9" diameters.

RECHUCK TO .0005" ON DUPLICATE PARTS WITHOUT FURTHER ADJUSTMENT!

The time, labor, and equipment costs you can save with a Buck Ajust-Tru chuck are little short of amazing. It lines up dead true *in less than a minute!* Rechucks duplicate parts *within .0005" at scroll chuck speeds!* Ends most needs for collets, step collets, stub arbors, mandrels, special fixtures. Adapts to lathes, screw machines, dividing heads. *Often doubles, triples output.* Get the *full* story. Send today for latest catalog.

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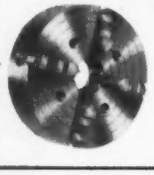


NEW 4-JAW INDEPENDENT CHUCK WITH GREAT NEW MACHINING ADVANTAGES!

Most chucks for 9" to 16" lathes are either too light and cheaply made to hold work securely, or too heavy for the lathe and clumsy to handle. Here's the chuck with the ideal weight — providing much more "holding power" and eliminating ⅝" overhang to improve accuracy, permit heavier cuts. 6", 8", and 10" models available. Send for latest catalog.

sonnel will show "the" place for the initial start of the quality control charts.

This does not mean that an armfull of control charts should be rushed down to this department and placed on every machine. The first few charts will arouse plenty of curiosity in the department, therefore, it is important that the proper place and personnel are available to insure initial success. The department foreman should be consulted as to what operators should be picked in order to obtain the best cooperation. From these few selected personnel the nucleus of the charting program will be formed. Gradually as more men become interested they should be added to the fold.

All the problems mentioned and many more will inevitably arise and each must be met and dealt with in turn. The installation of a statistical quality program in an organization means a number of changes must be made. Some bench inspectors will be changing to floor inspectors, 100% inspection will be changing to sample inspection, machine operators will be changing their methods of setting-up their machines, paper work will be changing, and numerous other changes will be constantly occurring until the program is firmly established. Naturally a constant changing policy in any organization will tend to disrupt the normal functions and cause a state of confusion. This is another good reason for setting the tempo of installing the program at a moderate to a slow speed in order to make the necessary adjustments as the changes are being made.

Screw Machine Story Told In Elaborate Four-Color Brochure

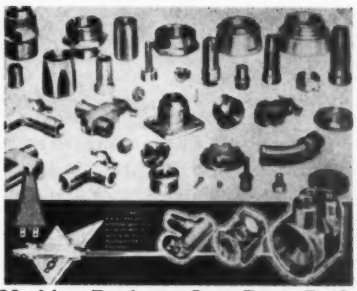
A most elaborate, informative and colorful brochure on the production and processing of precision screw machine products, parts and assemblies is now ready for distribution. Planning, development, engineering and processing to the final packaging and shipping problems are illustrated in detail with many "on the job" photos and scale drawings.

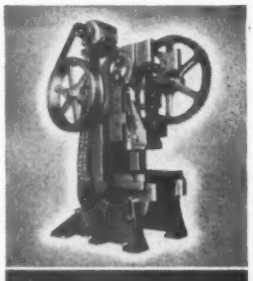
The book is produced on a special type paper and in four colors. It presents a multitude of screw machine products and facilities in so

detailed a fashion that they stand out from the page approaching three dimensional visuality.

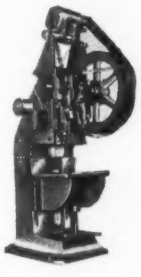
For a free copy, write to Z & W Machine Products, Inc., Dept. D-13, 5100 St. Clair Ave., Cleveland 3, Ohio or—

Circle Inform-A-Gram No. D2



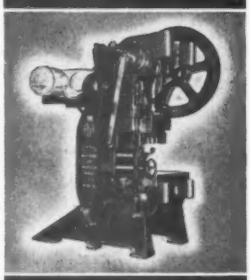


#700 B GEAR PRESS

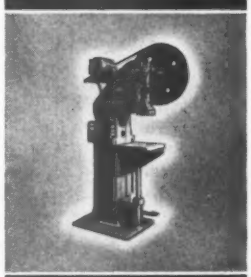


No. 55G WITH ADJUSTABLE BED PRESS.

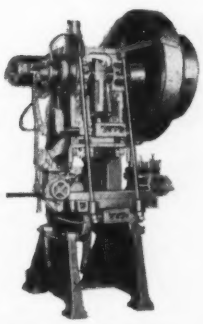
Illustrating a few of the many types and sizes of standard Perkins Presses. Presses built to customers' special specifications.



650-B PLAIN FLY WHEEL



3G HORN PRESS WITH ADJUSTABLE TABLE



No. 450B WITH AIR CLUTCH, VARIABLE SPEED DRIVE AND DOUBLE FEED ROLLS.

Perkins Power Presses SINCE 1885

PERKINS MACHINE CO.
WARREN, MASSACHUSETTS

Pressed Metal Institute Expands Activities

Immediate establishment of a technical and engineering department for the Pressed Metal Institute was recently approved by PMI's Board of Directors during a three-day executive session. The department will be headed by a full time technical director attached to the staff at PMI's headquarters at 2860 East 130th Street, Cleveland, Ohio.

This expansion is the culmination of a five year tangible service program for Pressed Metal Institute members started in March, 1949, and keeps the program on schedule. It also represents the largest single appropriation for improved membership service, since the first Pressed Metal Institute was founded in 1918.

Expanded technical services to members have been under study for some time and the Board's action was finally determined by an industry survey conducted by Armour Research Foundation of the Illinois Institute of Technology which proved that technical services could be received through PMI at a fraction of what the cost would be to an individual member.

This department will study those technical trends having a far reaching effect on industry; will provide liaison with other technical committees and the government; advise of technical advances in competing industries; publish a monthly technical bulletin; compile a handbook for the industry; and extend cooperation to engineering colleges.

It is anticipated that original research will eventually become a part of this program. Among items being considered, both from the standpoint of collating present known information and experimenting with information not now available, are the problems of metal flow, wrinkling, spring back, and die design in relation to metal flow. Similar problems will in turn be evaluated by the technical director and PMI's Technical Research and Standards Committee.

Other problems investigated by the appropriate executive committees during the three-day session included liaison with engineering colleges and universities in an enlarged program of information on metal stamping for the benefit of students, including recommended curricula brought up to date for current use. Cooperative advertising on behalf of members; an enlarged annual technical meeting with exhibits; and more basic research in marketing and original statistics were also discussed and programmed by these executive committees.

President of the Institute is Wallace F. Ardussi of the Variety Machine & Stamping Company, Cleveland, Ohio. Vice

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..... they save time — money — by keeping your expensive help at profitable jobs.
2. PORTER PUNCHES are made to "stand the gaff."
..... punches made in your shop are probably made from "available" material ... often the wrong metal for the job.
3. PORTER PUNCHES are offered in standard—and decimal sizes.
..... so your experienced help doesn't spend costly time "whittling."
4. PORTER PUNCHES are reasonably priced.
..... only a "specialist" can make punches as well—or as inexpensively.
Check your labor costs — your "down-time" — and order
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— for immediate delivery. Save time — save money — with top quality punches and die buttons. Look to Porter for
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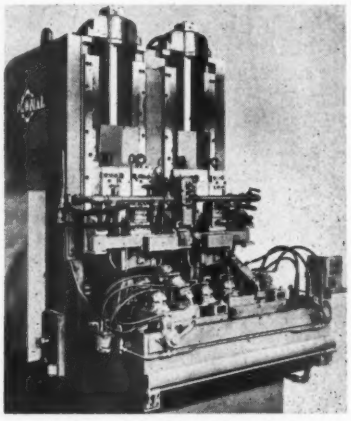
President is Samuel P. Hull of the Worcester Stamped Metal Company, Worcester, Massachusetts, and Treasurer of the Institute is Hunter Morrison, Jr., of Morrison Products, Inc., Cleveland, Ohio. Orrin B. Werntz is Managing Director and E. M. Ross is Assistant Manager.

Pneumatic And Hydraulic Shuttle Fixtures

As a means of reducing loading and unloading time to a minimum, and thereby speeding up the broaching operation on automotive brake shoes, pneumatic positioning and hydraulic clamping are combined on the shuttle fixtures of this broaching machine. The machine is a standard dual ram 10-ton 54-inch stroke, with specially designed shuttle fixtures. Insert type broaches cut a slot at one end and a concave notch in the other end at a rate of 400 brake shoes per hour.



Photos courtesy Colonial Broach Company

Fig. 1. Efficiency of pneumatic hydraulic shuttle fixtures contributes to production rate of 400 brake shoes per hour on this dual ram broaching machine.

Fig. 2. Concave and slot are broached simultaneously at opposite ends of this automotive brake shoe, removing 3/32" stock with insert type broaches.

Single manual control of three pneumatic cylinders enables the brake shoe to be positioned accurately against three stops with a flick of the control lever. Release of the part is just as fast, after broaching.

For Your Future
U. S.
SAVINGS BONDS

Hydraulic clamping, with a single cylinder actuating a saddle clamp, is an integral part of the automatic broaching cycle. Since there are two shuttle fixtures, one can be loaded and unloaded while the other is going through the broaching cycle, which also is a considerable factor in the efficiency of the operation.

Stock removal on both the ½-inch slot and the 13/32-inch concave notch is 13/32 inches maximum. Thickness is 13/32" at the concave and 3/16" at the slot.

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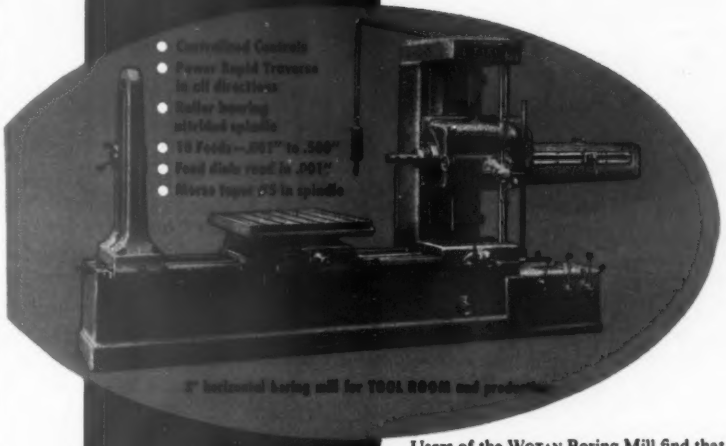
3" horizontal boring mill for TOOL ROOM and production

table top swivels full 360°

18 speeds—17 to 910 r.p.m.



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over 75 years of "know how" in the manufacture of precision production machinery

Users of the WOTAN Boring Mill find that advanced engineering and expert craftsmanship have combined to produce an outstanding piece of tool room equipment that is also well suited to long and short production runs.

Simplicity of design permits an unusually low price. Parker Machine Company has these mills on hand for immediate delivery. Write or phone John Schleiffer at our Brooklyn headquarters for full information.

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TOOL & CUTTER GRINDERS | ENGINE LATHES | HORIZ. & VERT MILLERS | VERTICAL TURRET LATHES | 16" AND 22" SHAPERS

"If I Could Be Eighteen Again"

by A. D. Hyde
Vice-President in charge of research,
GENERAL MILLS, INC.
Minneapolis, Minn.

"If I could be eighteen again . . . ."

That's no new wish. It is a favorite of many who are no longer eighteen. The wish probably reached its ultimate expression when George Bernard Shaw grumbled that "The trouble with you is that it's wasted on young people."

At any rate, if I **were** eighteen, I know what I'd be planning to do. I'd set out to explore the frontiers.

You say there are no more frontiers to explore? You've heard that there is no more unexplored land for eager, daring young men and women to conquer? Do you think our pioneering days are over?

Don't fool yourself. The day of the really visionary pioneer with important things to explore has just barely arrived. Our big discoveries are still ahead of us.

This familiar world of ours, old as it is, still clings to many secrets. You and I, together, can't begin to dream of all the wonders that are left to discover. There's lots and lots of elbow room left for explorers.

But there is one catch . . . . today's explorer is a brand-new variety. He is a skilled doctor, engineer, chemist, physicist, biologist—in short, a trained scientist with plenty of enthusiasm and imagination.

Yes, if I were eighteen I would be planning to go exploring in the world of science or engineering. And right now I'd be equipping myself for that adventure, moving ahead to get the tough, exacting special training which is so essential these days. A technical education is the only way to get the special tools necessary to work in the world of scientific research and development.

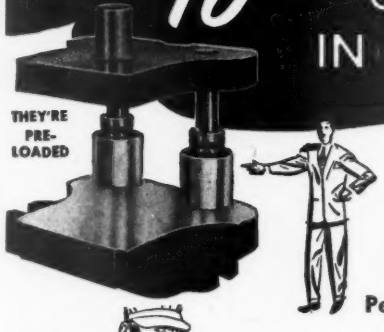
This education will equip you to take part in the exploring that is ahead of us. It is the exploring which, just since I was a youngster, has produced supersonic flight, television, atomic energy, and all the other modern miracles which we take for granted.

It also is the world which—very likely within our own life-

Reproduced by kind permission from the Scientific Manpower Issue of PROGRESS THRU RESEARCH, a quarterly publication of the Research Laboratories of General Mills, Inc., Minneapolis, Minn.

Editor's note: We feel that Mr. Hyde's words constitute a very inspirational message to any young person on the threshold of choosing a career. If you know such a youngster, you would do well to pass this on to him. We say this in full confidence of your (our readers) interest in the problems facing our future engineers. This was strikingly evidenced to us as a result of our July 1953 editorial, "a message for engineering students", which described an outstanding talk by an engineer to engineering students. To those of you who were interested we offered reprints of the entire talk for passing along to student engineers. You can imagine our gratification as the "returns" came in and we saw that you were so interested as to want nearly 2000 copies. E. W. P.

Save 15 Minutes OUT OF EVERY 60 IN DIE ASSEMBLY



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When you put dies mounted with Lempco Die Sets on a press you forget about maintenance. Such mishaps as frozen bushings, scored pins, pulled shanks or die damage just don't happen. More pieces per grind, less down time, close more accurately, produce pieces with cleaner edges and less scrap. For literature, write to Lempco Products, Inc. (Industrial Division), Bedford, O.

No pry bars, lead hammers or die pullers necessary!

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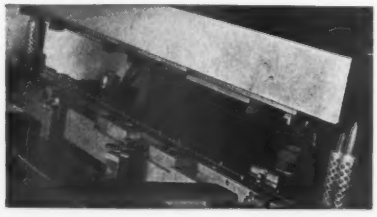


LEMPCO

times—will develop the power source which will replace our dwindling supplies of coal and oil . . . . and find new ways of getting the metal ores we must have to feed our ravenous industrial hunger for steel and iron . . . and discover a cure for cancer . . . and produce ways and means of giving more people better and cheaper housing . . . and make automobiles safer . . . and improve the nourishment of the world's growing population.

Even all this gives only a sketchy view of what it ahead in research and development. I can't imagine anything more exciting than planning to take part in it. There's so much to be done . . . but we must have the technically trained manpower to do it.

I know, of course, that not everyone is qualified either by interests or ability to get training in science or engineering. But many young people who **are** qualified don't get even as far as a high school diploma.

Only about one and one-half per cent of this year's 18-year-old crop will end up in the challenging, provocative world of science and engineering.

Why is this so? Certainly not because we lack young people with enough mental horsepower for college work.

I think one reason for this weak showing is simply that a poor job has been done in telling young people about the opportunities which exist in research and development.

If you are one of those with ability and interest in science, think about preparing yourself for a career in that field. You'll need a college education—and this country is full of colleges which can do a first-rate job of giving you anything from a liberal arts background followed by specialized training to a straight technical education.

You'll find that college is expensive. The costs of maintaining and operating educational institutions have gone up in recent years. It costs more to live while attending college, too.

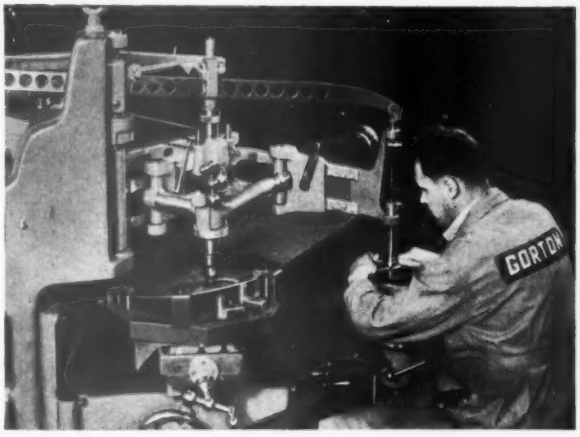
However, don't let the expense scare you away. You'll be surprised at the number of scholarships which can be had practically for the asking. Others can be won in various ways . . . you'll be smart to ask your high school principal about them. Later on, if you get into graduate work, you'll discover that more than half of today's graduate students have a teaching or research assistantship, or some other sort of fellowship or scholarship.

You'll also discover that you can earn good money during summer vacations. Many corporations now give students a chance to work in their laboratories during the summer. Work of that sort has the extra advantage of giving you a chance to see first-hand how industrial research is conducted. It's an education, itself, and you get paid while learning.

It has been said that the lucky combination of ability and adequate finances is usually necessary in getting a college education. This need not be entirely true. A lot depends upon your own initiative and ambition.

While you are getting your education, spend a little time finding out what people look for when hiring a scientist or engineer. I think that you'll discover that technical competence is just part of the story. Men

. . . *Continued on page 120*



Tracer-Controlled Pantograph cuts and rounds thermal slot in 8-foot steel propeller blade in 40 minutes; previous time was 5 hours, 10 minutes — just one of hundreds of examples of time and cost saving with tracer-controlled Pantograph machines.

Pantography IS NEW —

By George Gorton III
Executive Vice President
George Gorton Machine Co.

— in the sense that industry at large and Metal Working people in particular are just beginning to appreciate the many advantages Pantography offers to those faced with the Design-Production problems of today and tomorrow.

INDUSTRY'S foremost responsibility right now is to produce faster, to highest quality standards and at lower cost — whether on defense contracts or for our civilian needs.

Today, there are literally thousands of operations being performed throughout industry which can be speeded up, improved in quality and lowered in cost by the use of available models of special machine tools. The modern tracer-controlled Pantograph machine is such a tool. It is both a special purpose machine, ideal for short runs, and it is an accurate single purpose machine which turns out identical parts or pieces to meet tight production schedules.

The tracer-controlled Pantograph machine is used for inside and outside profiling, routing, die sinking, mold cutting, counterboring, contour milling, chamfering, grooving, graduating and engraving in ferrous and non-ferrous metals, as well as in plastics.

This machine performs on flat, uniformly curved, cylindrical, spherical or irregular shapes — it works in either 2 or 3 dimensions, in all directions on a horizontal plane, and vertically. It employs enlarged masters, templates or patterns which are quickly and easily made and operates normally at a reduction ratio thereby increasing accuracy — exclusively characteristic of the pantograph.

Single or repetitive accuracy — from one piece to thousands — manual or full automatic operation depending upon quantities — work sizes from the size of a dime to as large as 10 feet.

A new booklet, "Pantography," explains the process and shows what this type of machine can do for you. It is yours without obligation. Write for it today. If interested, also ask for our latest General Catalog 1655. Address the George Gorton Machine Co., 1210 Racine St., Racine, Wisconsin, U. S. A.

Robot "Guinea Pig" Extends TV Tube Life

In many manufacturing operations, conventional control of atmospheric temperature in a continuous oven may leave some room for error where the surface temperature itself is critical. Particularly where the surface temperatures must follow a definite cycle, some means is necessary to "log" these temperatures in order to determine the correct setting of conventional temperature-control instrumentation.

An electronic "guinea pig" is being employed at RCA's Lancaster (Pa.) picture-tube plant to monitor temperatures in straight-line exhaust ovens. This method, developed in collaboration with engineers from Minneapolis-Honeywell's industrial division, is helping to produce a new video tube that will provide a sharper picture and longer life than those made by conventional methods.

As the picture tube passes through the ovens, the glass envelope is freed of gas by baking at high temperatures. These temperatures must be rigidly controlled for each type of picture tube. If this isn't done,

strains may be set up in the glass, particularly at the faceplate and wall of the tube, and may result in breakage.

The "guinea pig" is a sample tube to which are attached five thermocouples. These, in turn, are connected to an electronic potentiometer that records on a continuous chart the temperature being "sensed" by each of the five thermocouples. The tube and potentiometer are sent through the ovens on the same type fixture that conveys the regular production tubes through the ovens.

For Your Future
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At scheduled intervals during the day, the "guinea pig" travels through the exhaust ovens, emerging with a charted temperature reading for the particular tube in production. The recorder indicates the exact location and magnitude of any temperature deviations, and necessary adjustments can be made immediately. Exhaust schedules for new tube types can be readily established and evaluated by running a curve as the "guinea pig" rides through the oven.

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THERE IS NO ESCAPING THE DUST COLLECTING ACTION OF THIS
TORIT DUST COLLECTOR

In this Wheelabrator fine, abrasive dust particles circulate into the upper chamber. They are *through the line* ready to do damage, when they are *socked* by the powerful suction of this Torit No. 75 Dust Collector. It's a *mousetrap* play that's paying big dividends in cleaner working conditions and better employee relations.

When you are looking for *high scoring* production it pays to have Torit Dust Collectors on your *team*. Compact and self-contained they fit easily into production *lines*. Sturdily constructed they are *sixty minute players* with practically no time out for repairs or maintenance.

To learn how Torit Dust Collectors can help produce a *winning team* for you just write:

see our catalog in MACHINE TOOL CATALOGS or write for copy

Torit also manufactures a line of cyclone type dust separators. Sizes up to 5 H.P., with or without after-filters.

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NATIONAL METAL EXPOSITION

Over 25,000
TORIT DUST COLLECTORS
Now in Operation

New Hydraulic Powered Machine Expands and Sizes Metal Tubing

A vertical tube expanding machine, first in a new line of hydraulic powered machines for expanding and sizing metal tubing is announced by a Detroit builder of tube bending and forming equipment.

The vertical machine is a manually controlled type that is particularly adapted to the expansion and sizing of copper tubing in evaporator and condenser coil assemblies. The model illustrated has expansion mandrels mounted on one-inch centers.

Photo courtesy Walter P. Hill, Inc.

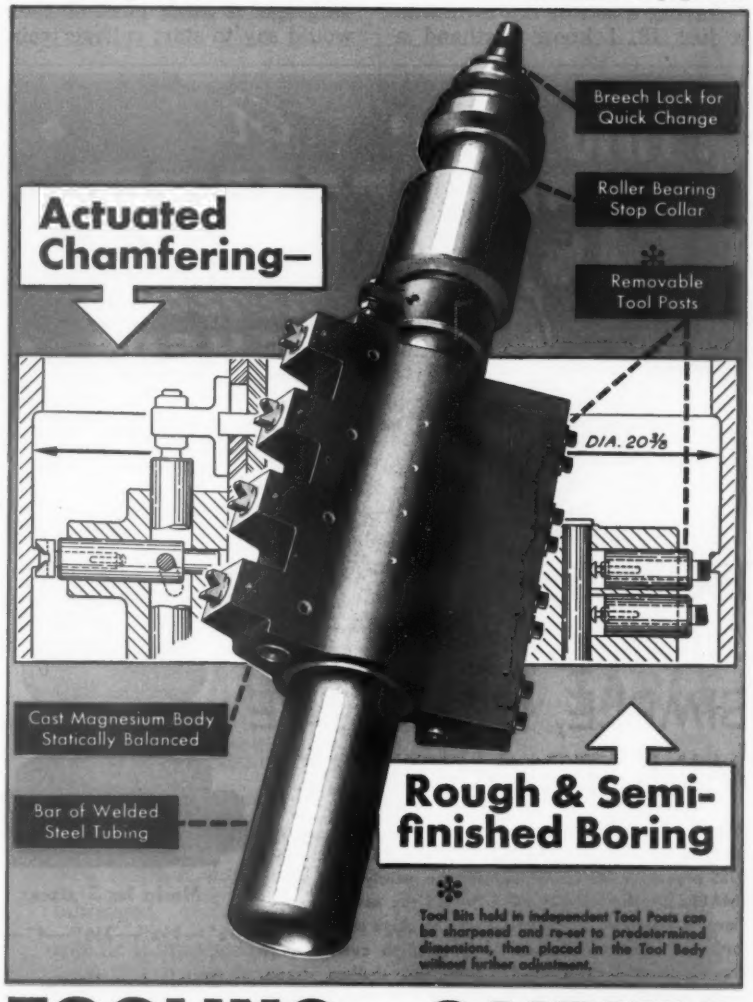
These mandrels expand sixty 3/8" diameter, 0.020" wall copper tubes in an evaporator assembly to provide thermal-conducting, mechanical joints between the tubing and a stack of cooling fins.

Another set of sixty mandrels, through which the expanding mandrels feed, are picked up near the end of the down-feed to size the ends of the tubing for soldered return bend fittings by expanding them an additional 0.026". Cycle time for the operation, including loading, expanding, sizing and unloading, is 40 seconds.

In operation, the evaporator tubing and fin assembly is placed in a fixture on the machine table and hydraulically clamped in position by actuating the left hand hydraulic control valve. Then the right hand control valve is actuated, causing the mandrel assembly to feed to depth, thus expanding and sizing the tubes. At the end of the down-feed, the right hand control valve is reversed, causing the mandrel assembly to withdraw from the tubing and return to the top of the stroke.

Two hydraulic cylinders in the base of the machine, control the mandrel feed and return functions through two draw rods. The expanding mandrels have hardened steel bullet noses and are supported by retaining plates that are guided on the draw rods and stack up as the mandrels are fed to depth. The shorter sizing mandrels are supported by a mounting plate that is also guided on the draw rods. A sep-

. . . Continued on page 122


Actuated Chamfering–
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DIA. 20 3/8
Cast Magnesium Body Statically Balanced
Bar of Welded Steel Tubing
Rough & Semi-finished Boring
Tool Bits held in independent Tool Posts can be sharpened and re-set to predetermined dimensions, then placed in the Tool Body without further adjustment.

TOOLING by GAIRING

Few of you will recognize the operation pictured here. Part of our defense effort, its exact nature cannot be divulged • All of you, however, will agree that the engineering and manufacturing skill to make tools of such apparent complexity and size — and to make them successfully — should put GAIRING into first place for consideration whenever you require special tooling of any description • May we ask our nearest representative to call?

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. . . Eighteen Again, from page 117

running our research and development laboratories want more than just a well-trained man or woman. They also want a man or woman who will fit in well, personality-wise, with the rest of the group. Research and development work is to a large extent teamwork, and you'll be expected to be a good team player. A friendly, cooperative personality is often as valuable in scientific work as straight "A" grades through four years of chemistry.

Having a son of my own who is just 18, I know firsthand a little bit about another problem which bothers 18-year olds. It's this business of military service, which to a young man, raises a serious problem. Should he, for example, start college this year perhaps to have it interrupted in a year or two by military service? Or should he get his service over with first? What should he do with this element of uncertainty clouding his future?

A lot of today's promising young engineers and scientists had the same experience not too long ago. I think most of them would say to start college training now, just as if the draft did not exist.

When and if called, chances are that the interruption will not be serious. It's easier than you may suspect to come back and pick up studies right where you left off. Veterans after World War II had consistently higher grades than they had received before the war. They also had higher grades than most non-veterans.

So don't let prospects of service upset and spoil your long-range plans. Current draft policies make it possible for many young men to finish their educations, anyway.

Recently the National Manpower Council made these recommendations in regard to student deferment:

1. That the policy of deferring qualified students until they complete their education receive public support.

2. That dependency be removed as grounds for deferment, in order to insure that postponement from service does not turn into permanent exemption.

3. That the President retain present provisions which permit qualified students in all recognized fields of study to be given equal consideration for deferment.

4. The President retain the present method by which students can qualify for deferment on the basis of either their score on the Selective Service Qualification Test or their class standing.

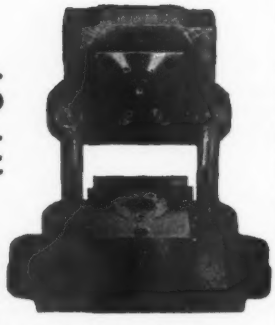
These four recommendations are part of the list. If the policy is followed, the prospect of military service should not discourage anyone from entering college for specialized training.

All indications are that there will be a long-continuing demand for scientists and engineers. I'm sure there will be a job waiting for the graduate of 1958. Today we have about 160,000 engineers and scientists in the United States. If that sounds like a large number, consider that right now there is a shortage of more than 60,000 engineers. Moreover, it is estimated that our need for new science and engineering graduates is in excess of 60,000 per year.

And what is the supply? Last June about 35,000 young men and women graduated to fill

"A MUST wherever WASHERS are made!"

HOVIS
OFFERS YOU THIS SIMPLE, UP-TO-THE MINUTE METHOD



There's no need to make a complete new Die for any type washer or blank. The HOVIS UNIVERSAL WASHER DIES provide a Master Holder and by merely changing 5 SMALL, EASILY REMOVABLE PARTS the new washer or blank is produced . . . Special sets of parts are available for use in Master Washer Units enabling customers to produce irregularly shaped pieces and shallow draws. Multi-Washer Dies are also designed and manufactured.

Made in 5 sizes:
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Write for literature.

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8100 E. NINE MILE ROAD
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VAN DYKE, MICHIGAN
Suburb of Detroit

those 60,000 jobs. Next year it will be a little lower—about 30,000 graduates. The classes of 1955 and 1956 should be a little larger, particularly in such fields as chemistry.

But there is no indication that the supply—even if it increases—will begin to match the demand for many years to come. Industrial research and development have increased five times in the last ten years and government research has expanded even more than that. But during the same period the number of scientists and engineers has barely doubled.

The field is wide open for scientific explorers. Right now our big problem is that of finding enough people qualified to do the work. If I were eighteen again, I would be readying myself for a career in America's exciting research and development work.

Carbide Tip Finish vs. Performance

Don't use a lapped or superfinished cemented carbide cutting tool during roughing operations in machining steel. It's a waste of man-hours to provide such a finish on a tool.

According to Carboloy Department of General Electric Company, the surface finish on a carbide tool tip has little effect on tool life for average machining on steel. During roughing operations, it points out, carbide tools perform satisfactorily whether they are ground on a diamond or silicon carbide grinding wheel—or even if left with the surface in as-sintered condition.

These are the surface finishes which can be obtained on cemented carbides by various methods of grinding or lapping.

As-sintered carbide tools provide a tool surface finish of 30 plus micro inches. Those ground on silicon carbide grinding wheels provide 15 plus micro inches. Eight to fifteen micro inches are obtained with diamond grinding wheels, and lapping and super finishing reduce surface finish to 0.5 to 5 micro inches.

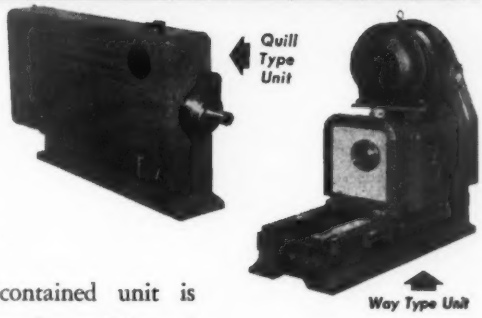
Tests conducted at Carboloy Department indicate that a lapped or superfinished tool fails more rapidly in making roughing cuts than one ground on a diamond wheel. This is because the lapped surface over which the chip slides offers more area contact, increasing both the rate of heat transfer from chip to tool tip and friction due to sliding. A slightly rougher tool surface offers less surface contact and operates at lower temperatures.

Tools employed for finishing and precision finishing aluminum, magnesium, etc., must have a good surface finish. Lapping of the top face and cutting edges is a must for good tool life.

For a precision finishing operation involving steel, it is necessary to finish grind the tool cutting edges with a diamond wheel. Long-run jobs, using quick-change tool holders, require the use of a duplicating type grinder to control uniformity of the cutting tool shape. These duplicating grinders often use a 400 grit resinoid bonded diamond wheel. But in this operation, very little stock is removed since it is more of a truing up operation.

Rough grinding of precision finishing tools may be done by off-hand grinding with a 100-grit silicon carbide or diamond wheel.

HYDRAULIC POWER UNITS



Here are the simplified, leak-proof, accurate hydraulic power units for all your special machine applications.

A completely self-contained unit is available in a variety of capacities and models to suit every design requirement.

They can be used for drilling, reaming, boring, milling, facing and many other operations, indivdually or simultaneously.

HYDRAULIC INDEX TABLE

This table is driven by a fluid motor and is locked in the indexed position by a hydraulically operated shot bolt. The table rides on hardened and ground wear strips, is automatically lubricated, and the table spindle is mounted in heavy-duty tapered roller bearings.

Can be furnished in sizes 30", 36", 42" and 48".

Lee Engineering Company, Inc.
4700 BURLINGAME • DETROIT 4, MICHIGAN

. . . Hydraulic Machine, from page 119

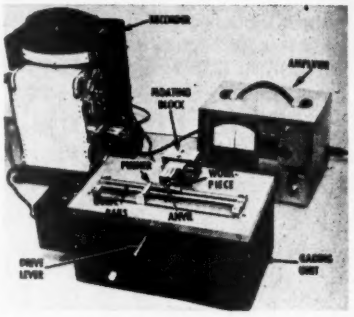
arate hydraulic pump and tank unit driven by a 15-hp motor provides 20 gpm of oil for actuating the hydraulic cylinders.

These vertical tube expanding machines are built in a variety of sizes, including completely automatic types, to meet special requirements. All sizes have welded steel bases and separate hydraulic pump units. The model illustrated is 7-ft. high, with a 40" by 36" base and has a 30" open height.

Special Gaging Equipment Records Deviation from Diameter in Millionths

An unusual gaging problem was recently posed by a defense contract that called for the manufacture of cylindrical pins whose diameter must be checked at four points to plus or minus 0.000005". For inspecting these production parts, Cleveland Instrument Company developed the special gaging equipment shown in the accompanying photograph. Operation is as follows:

The operator places a work-piece on a pair of cylindrical guide rails, using tweezers to prevent distortion due to body heat. He then depresses a lever at the front, and a motor-driven pusher pushes the work to the right at constant speed along the guide rails between an anvil and gage head. The recorder chart shows the deviation from nominal diameter in millionths of an inch along the full length of the work. The chart paper is synchronized with the movement of



the work past the gage head; so the operator can read the measurements at any desired points along the length of the piece.

The measuring element consists of a Cleveland Micro-Ac gage head and amplifier. The gage head is beneath the top plate, and has a special cylindrical contact tip at right angles to the axis of the work-piece. The tip contacts the under side of the work; and a corresponding cylindrical fixed anvil, parallel to the cylindrical tip, contacts the top of the work as shown. The gage head and anvil are mounted on a single rigid block, which is attached to the frame by reed-type springs so as to swing freely without friction or backlash.

The floating-block mounting of the gage head and anvil, plus the construction of the anvil and contact tip, prevents any error that would otherwise result from the work-piece moving slightly out of position as it travels along the guide rails. These features also assure that the unit measures only the actual diameter of the work, regardless of the straightness.

Sid Tool Company

WHY WAIT FOR SPECIAL TAPS?

. . . Has them IN STOCK for IMMEDIATE DELIVERY!

HIGH SPEED SPECIAL RIGHT HAND TAPS

SIZE	THREAD
4	32-48-60-64
5	30-32-36-48-60
6	36-40-48-56-60
7	32-40
8	24-30-36-38-40-44-48
9	24-28-32-40
10	28-30-36-40-48-64
12	20-28-32-36
14	20-24-28
1/16	60-64
5/64	72
3/32	48
7/64	48-56
1/8	32-40
5/32	32-36-40
9/64	36-40
11/64	36
3/16	20-24-32
13/64	32
7/32	24-28-32
1/4	18-24-26-27-30-32-36-40
5/16	18-20-22-27-28-32-40
3/8	12-16-18-20-27-28-32-36-40-48
7/16	12-16-18-22-24-27-28-30-32-36-40
1/2	12-14-16-18-22-24-26-27-28-30-32-40
9/16	18-20-24-27-28-30-32-40-48
5/8	12-14-16-20-24-27-28-32-36-40
11/16	11-16-18-20-24-27-28-30-32
3/4	9-11-12-14-18-20-24-26-27-28-32
13/16	10-14-18-20-32
7/8	10-12-16-18-20-24-27-28-32
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1	10-12-16-18-20-24-27-32-40
1-1/16	12-14-16-18-20-24
1-1/8	8-10-14-16-18-20-24-32
1-3/16	8-10-12-14-16-18-20-24
1-1/4	8-10-14-16-18-20-24-32
1-5/16	12-14-16-18-20-24-32
1-3/8	8-10-14-16-18-20-24
1-7/16	8-10-12-16-18-20-24
1-1/2	8-10-14-16-18-20-24-28
1-9/16	18-20-24
1-5/8	5½-8-10-12-13-16-18-20-24
1-11/16	10-12-14-16-18-20-24
1-3/4	8-10-12-14-16-18-20-24
1-13/16	8-10-12-14-16-18-20
1-7/8	8-10-12-14-16-18-20-24
1-15/16	8-10-12-14-16-18-20-24-28
2	4-1/2-8-10-12-16-18-20
2-1/16	12-14
2-1/8	12-16-20
2-3/16	12-16
2-1/4	4-½-8-12-14-16-18
2-5/16	12-18
2-3/8	12-16-18
2-1/2	8-10-12
2-9/16	18
2-5/8	12-16-20
2-3/4	16
2-7/8	8-12-16
3	8-16
3-1/4	8-12-16
3-1/2	8-12-16
3-7/8	6
4	8-12

HIGH SPEED LEFT HAND TAPS

SIZE	THREAD
0	80
1	56-64-72
2	56-64
3	56
4	32-36-40-48
5	40-44
6	32-36-40
8	32-36-40
10	24-30-32-40
12	24-28-32
1/4	20-28-32
5/16	18-20-24-28-32
3/8	16-24-32
7/16	14-20-28
1/2	12-13-20-28
9/16	12-18-20-24
5/8	11-12-18-20-24
11/16	11-16-24
3/4	10-16-18-20
13/16	16
7/8	9-12-14-18-20
1	8-12-14-16-18-20
1-1/8	7-12
1-1/4	7-12-16-18
1-3/8	6-8-10-12-16-18-20-24
1-7/16	8-10-12-14-16-18-20
1-1/2	6-8-10-12-16-18-20
1-9/16	8-10-12-16-18-20
1-5/8	8-10-12-14-16-18-20
1-11/16	8-10-12-14-16-18-20
1-3/4	8-10-12-14-16-18-20
1-13/16	8-10-12-14-16-18-20
1-7/8	8-10-12-14-16-18-20
1-15/16	8-10-12-14-16-18-20
2	4½-10-12

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Prices on Application — We are always adding new sizes

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A clamp knob at the front of the gaging unit provides for setting the length of travel of the pusher to suit the length of work-piece. When the work is pushed beyond the gage head, the pusher automatically returns to starting position at fast travel and stops.

With work-pieces of 2" length, this equipment gages up to 120 pieces per hour. Dependability of measurement is assured by the drift-free amplifier and by the frictionless movement of the gage head, which has no mechanical amplification. The equipment can be used in any room where the temperature is reasonably constant.

This particular job did not require automatic handling of the work. Automatic feeds can be provided, together with automatic sorting chutes actuated by the amplifier. Also, the speed can be increased.

Further details on the design and operation of this equipment are given in Bulletin 531, available on request from Cleveland Instrument Company, 735 Carnegie Ave., Cleveland 15, Ohio, or **Circle Inform-A-Gram No. D1.**

Timken Company Eliminates Week-end Truck Shipments to Promote Highway Safety

The highway accident death toll in America has reached dreadful proportions, exceeding in a year's time casualties from the Korean battlefront. Holiday weekend traffic tragedies have been particularly serious. In an all-out effort to do its part in promoting safety on the nation's highways, The Timken Roller Bearing Company has curtailed all inbound and outbound truck traffic between its various plants, to customers, and from suppliers, between midnight, Friday, and midnight Sunday. Only in extreme emergencies, when customers' production schedules would be seriously affected, are exceptions made to this rule of no weekend truck shipping.

From May 30 through June 30, the first month of the new safety program, 1816 truck loads were shipped with only five shipments made over the weekends. A total of 249 truck loads were not shipped over weekends during June which normally would have gone out. The Timken Roller Bearing Company, since inaugurating this safety program, has received excellent cooperation from the many trucking firms hauling for the company, and from the many Timken Company customers. Production schedules have been unimpaired, and bearing orders have flowed smoothly.

Both public and company officials are hopeful that other industries in Ohio and other states will follow the lead of the Timken Company in promoting highway safety.

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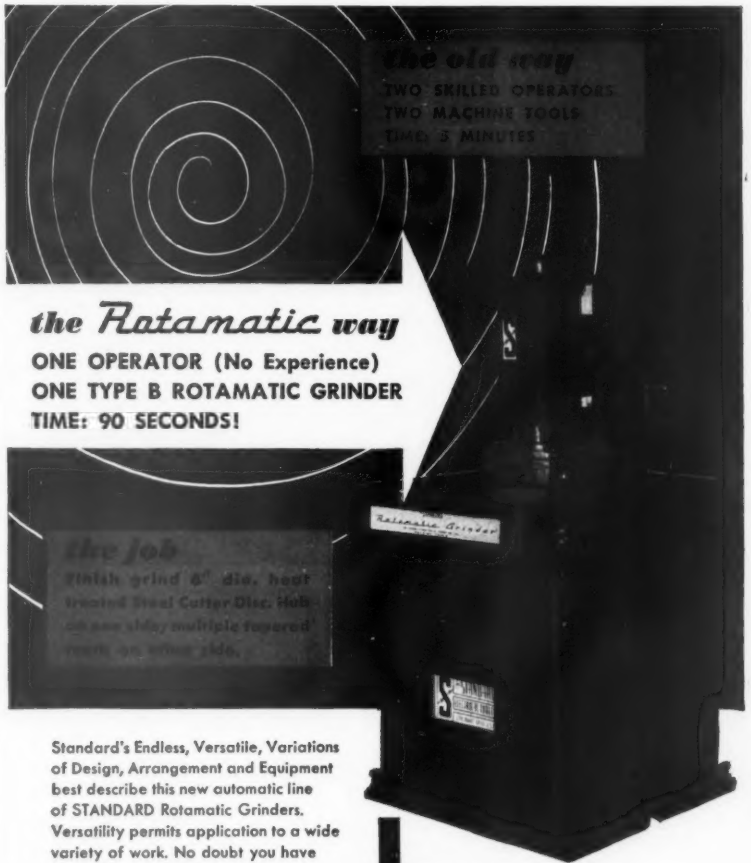

Standard's Endless, Versatile, Variations of Design, Arrangement and Equipment best describe this new automatic line of STANDARD Rotamatic Grinders. Versatility permits application to a wide variety of work. No doubt you have grinding problems that Rotamatic can solve quickly and efficiently. Write us today for Catalog AG and complete details.

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Standardize with

the STANDARD electrical tool co.

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See this machine in operation; National Metal Exposition, Cleveland; October 19 - 23, Booth 840

1953 - METAL SHOW - 1953

Come October 19 an estimated 50,000 executives, engineers and designers, scientists and technicians—all in the metal working world—will converge on Cleveland for a panoramic look at a year of progress in metals processing.

The "Biggest Metal Show on Earth" is of huge proportions, touching every phase of the metals industries from mine to mill and factory. And for 35 years manufacturers large and small have been shooting for the Metal Exposition as the primary target for unveiling whatever they have been able to develop in new products or services.

Interest in new developments is shared by virtually everyone connected with metals. The introduction of a single new alloy or a new testing or fabrication method may reach deeply into the business lives of a great many Americans.

On display in Cleveland's auditorium from October 19 through 23 will be everything from multiton heavy-duty machines to gadgets weighing but a few ounces.

There will be, for example, a new version of a centerless grinder able to handle surprising sizes and lengths of work.

There will be air-powered tools that work so fast and so accurately that present cost and production figures will become obsolete as the flintlock musket.

A timely and hard-hitting group of electric, electronic and other automatic controls will be featured by a dozen or so specialists in this field. They will enable existing equipment to do work better, faster and at a saving.

For the technicians who must "look inside" metals to verify their strengths or wear resistance or fatigue factors, there'll be on display a high-powered portable X-ray unit that fits into the trunk of an average automobile and can be handled by a two-man team anywhere, on any job.

A brand-new 'scope that lets inspectors look around corners, peek into heretofore unreachable places, check any surface will be on hand.

Metals that can be bonded together as surely and as easily as an envelope is sealed will be on display.

Then there's a special item for the fellows in the original equipment materials field—a lightweight, multi-purpose midget pump that can deliver up to 22 gallons per minute up to 21 feet of head.

Television will get into the act with demonstrations showing how it solves problems of materials flow on production lines.

All in all, the Exposition will highlight the greatly improved and the sharply stepped up efficiencies of machines, methods and processes. And for those Exposition visitors who incline to philosophical musings, there will be ample evidence of the importance of modern machinery and methods in helping to create a better world in which to live.

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FOR ALL *grinding · sanding · filing · polishing*

Why burden skilled hands with the chore of manhandling bulky, heavy, conventional grinders? Haskins flexible shaft equipment furnishes all the power required for the job—without the weight. And the Haskins line includes models with horsepowers, speeds, tools and attachments that will exactly suit your job. Write for the latest catalog which describes all models.

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KEY TO SURVIVAL AND GROWTH

A booklet entitled "Key to Survival and Growth" summarizing training methods for use in the metalworking industry has just been published by the National Machine Tool Builders' Association.

The booklet is an outcome of a study of training methods made by the Training Standards Committee of the Association under the chairmanship of D. F. Pratt, Director of Apprentice Training of the Cincinnati Milling Machine Company. Other members of the Committee are:

Dean William D. Bliss
Supervisor of Training Programs
Kearney & Trecker Corporation
Milwaukee, Wisconsin

Edward W. Gressle
Industrial Relations Manager
The Warner & Swasey Co.
Cleveland, Ohio

John H. B. Machon
Director of Apprenticeship
Brown & Sharpe Mfg. Co.
Providence, Rhode Island

The booklet reviews Learner Training programs, Apprentice Training programs, and Graduate Engineering programs currently in effect in many machine tool companies and lays down specific instructions whereby any company, large or small, can start effective training.

A major emphasis of the booklet is upon specific methods of inaugurating a Learner Training program. The Association has previously published, and has available, a booklet entitled "Apprentice Training Standards" which outlines the detail and procedures for such training; and, as the new booklet points out, training for Graduate Engineers constitutes chiefly an acceleration of Apprentice Training methods.

"The purpose of this report," the booklet states, "is to outline certain basic principles which appear common to most of the training programs which have been constantly and successfully in operation for some period of time as a guide to companies who may wish to adapt these principles to their own circumstances.

"Unless training becomes an integral part of top management planning, it soon degenerates into a makeshift arrangement which becomes lost in the detail of production problems. Top management cannot entirely delegate the responsibility for continuity and determined consistent policy in good times and bad.

"The training program should be placed in charge of one man who is responsible for the program and who reports to top management.

"A training program is easier to apply and not as expensive as you may think. Any company that applies itself earnestly to the problem can find a simple and effective way to do it."

A comprehensive bibliography and summary of movies, covering training subjects, constitutes an Appendix to the booklet.

Copy of the booklet may be obtained by request from the National Machine Tool Builders' Association, 10525 Carnegie Avenue, Cleveland, Ohio.

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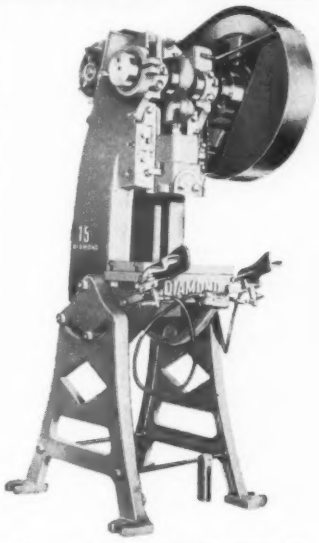

Diamond 15-ton open belt press illustrated with optional air controls. Sizes range from 9 to 60 tons. Open belt and back geared.

SEASONED CASTINGS—Above photo illustrates a partial view of Diamond press frames outdoors under exposure to all weather conditions. They are left to season by this natural process for an average period of three years. This assures castings of the highest quality.

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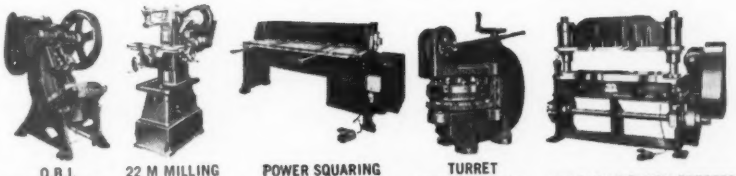

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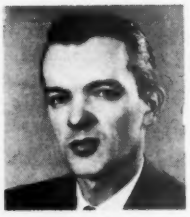
MEN YOU SHOULD KNOW . . . . . .

Arvin W. Harrington

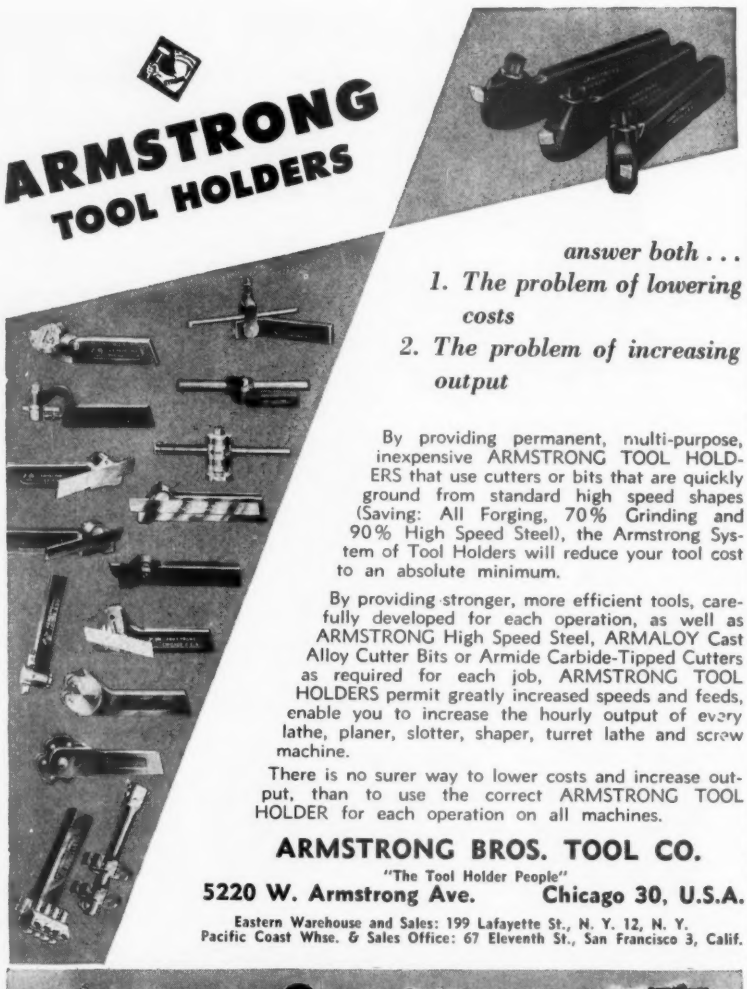


Glen W. Goodloe

Howard U. Herrick

Ralph Edwards

Edward P. Cody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There is no surer way to lower costs and increase output, than to use the correct ARMSTRONG TOOL HOLDER for each operation on all machines.
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Arvin W. Harrington will serve as sales representative in metropolitan New York and Connecticut for the Carpenter Steel Company's Alloy Tube Division, Union, N. J. He formerly was sales manager in the Caribbean area for Burroughs, Inc.

◆

The appointment of Glen W. Goodloe as assistant manager of the Transportation Market of the Reynolds Metals Company's General Sales Organization has been announced. Mr. Goodloe comes to the Louisville, Ky. main office from the Witchita, Kan., sales office.

◆

Howard U. Herrick, president of the E. W. Bliss Co. in Canton, Ohio has consented to continue as a senior executive of the firm for a three-year period starting November 8, 1953. Mr. Herrick was with Bliss as executive vice president from 1934 to 1944 and rejoined the company as president in 1951.

◆

The Hanson-Whitney Co. of Hartford, Conn. has named Ralph Edwards as general sales manager of machine tools and Edward P. Cody general sales manager of small tools and gages. Mr. Edwards joins Hanson-Whitney after 20 years of diversified experience in the machine tool industry. He was previously associated with the Keller Tool Co. Mr. Cody has been with Hanson-Whitney since 1924.

MEN YOU SHOULD KNOW

E. J. Vargo

Edmund J. Klonowski

Theodore F. Eserkaln

Rudolph Winters

Edgar L. Bailey

E. J. Vargo has been appointed assistant production manager of the Wellman Bronze & Aluminum Co. in Cleveland. Associated with the firm for 11 years, Mr. Vargo was works manager of Ebaloy Foundries in Rockford, Ill., the past year.

◆

Edmund J. Klonowski has been named general sales manager of the Pivot Punch and Die Corp. in North Tonawanda, N. Y. Appointed to the newly created position of Director of Cost Planning was Frederick J. Rueger, report company officials.

◆

New chief engineer for the Kempsmith Machine Co. of Milwaukee, Wis. is Theodore F. Eserkaln. Mr. Eserkaln is scheduled to direct an accelerated program of engineering developments at Kempsmith.

◆

Clearing Machine Corp. of Chicago has announced the appointment of Rudolph Winters as superintendent of its Hamilton, Ohio plant. Mr. Winters joined Clearing in 1940 and until recently was a foreman in the Chicago plant.

◆

Retirement of Edgar L. Bailey as staff electrical engineer of Chrysler Corp. after more than 23 years of service has been reported by the company. Prior to his retirement, Mr. Bailey was in charge of all plant electrical engineering for Chrysler.

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Speed up operations with INDEX MACHINES as an aid in meeting today's high pressure tool room and production plant service. They assure you peak performance while holding to the Index reputation of precision and economy . . . For those heavy-duty jobs where increased speed and feed range are required, you will find your answer in this strong, rugged MODEL 55 VERTICAL MILL (Pictured). Capacity 1/8" to 1 1/2" end mills in steel and a table working surface of 32" x 9" or 38" x 9", Overall 40" x 9" or 46" x 9".

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A machine that emphasizes the combination of Precision, Production, and Economy . . . It embodies many features that provide for faster, more economical milling, resulting in a substantial cut in production costs . . . It is sufficiently rugged for day-to-day operation and can also be used for accurate boring and locating . . . Capacity 1/8" to 1" end mills in tool steel. Table working surface 8" x 26", 8" x 34" overall.

MODEL 60 HORIZONTAL MILL
A versatile machine with simplicity of design that permits an unusually low price while reflecting quality, accuracy and practical utility . . . A product where advanced engineering and expert craftsmanship have joined to bring out an outstanding piece of equipment adapted to tool room use, yet sufficiently rigid for the requirements of production shops . . . Standard table 40" x 9" with larger table optional. Equals or exceeds a light No. 2 in capacity.

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INDEX MACHINE CO.

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High Alloy Castings in Heat Treating Equipment Resist High Temperature Conditions

Because of the ever-increasing severity of modern industrial processes, engineers must now rely on materials especially suited to vigorous conditions of high temperature and pressure. According to the Alloy Casting Institute, the technical association of high alloy foundries, these conditions are making new demands on metallic components of equipment used in heat-treating, chemical processing, and elsewhere.

The design of such equipment is complicated by hot gas corrosion of metal parts used for continuous or intermittent service above 1200° F, where almost any atmosphere tends to be corrosive. Hot gas corrosion causes progressive scaling, which can eventually reduce the sectional area of an exposed structural element, with consequent loss of load-carrying ability.

Engineers not actively concerned with high temperature design may be unfamiliar with the properties of a group of alloys that retain mechanical strength at high temperatures, and also resist corrosion from various types of hot gas. These are the chromium-nickel-iron cast high alloys (greater than 8% alloy content), which are divided by the Alloy Casting Institute into corrosion-resistant and heat-resistant groups. In the heat-resistant group, 12 cast alloy compositions are recognized as standard (Alloy Casting Institute "H" series), and within this general classification, there are three distinct types:

A. Iron-chromium castings containing up to 30% chromium and under 7% nickel (types HC and HD). Type HB alloy, containing only 18% chromium and useful only up to 1500° F, is sometimes also included in this group. These ferritic alloys offer excellent resistance to oxidation and sulphur-containing atmospheres, although they have moderate hot strength.

B. Iron-chromium-nickel castings containing 18 to 32% chromium, 8 to 22% nickel, with higher chromium than nickel content (types HE, HF, HH, HI, HK, and HL). Partially or fully austenitic, these alloys have greater high temperature strength and ductility than the straight iron-chromium group, will withstand greater loads and temperature cycles, and can be used in sulphur-bearing, oxidizing, and reducing atmospheres.

C. Iron-nickel-chromium castings containing from 30% to 70% nickel and 10 to 20% chromium (types HT, HU, HW, and HX). These alloys are fully austenitic, maintain excellent hot strength in applications up to 2100° F, and have good life under rapidly fluctuating temperatures. They withstand reducing and oxidizing atmospheres, do not carburize excessively, and do not take up nitrogen in a nitriding atmosphere. The high nickel content makes this group unsuitable for use in atmospheres containing substantial amounts of sulphur.

Most of the chromium-nickel-iron cast alloys suitable for high temperature service also withstand the effects of one or more varieties of heat treating atmospheres — oxidizing, reducing, and various types of sulphur-bearing fuel gas environments.

From the many industrial applications in which the three basic groups of heat resistant alloy castings have been successful, the following examples have been chosen to show how the alloys provide various combinations of mechanical properties and hot gas corrosion resistance.

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The Nichols Miller, with "rise-and-fall" spindle, is one of the most precise, universal machines available today. The four models shown, fill most basic requirements — whether for single parts with simple set-up, or multiple operations on mass production jobs with tolerances to "tenths". Their versatility makes possible such operations as facing, boring, recessing, turning, slotting, key seating and contour milling, as well as regular milling. According to requirements, screw or lever longitudinal and transverse table feeds are available optionally. "The miller that uses its head" is your best choice — and one of industry's greatest values. If you want production to "tenths", investigate the Nichols Miller.

"the miller that uses its head!"

Write today for the Nichols general catalog, which describes the six models of Nichols Millers. A sound, color movie "the Miller that Uses its Head" is available for free showing. May we reserve it for you?

CONDENSED SPECIFICATIONS

Table Working Surface	6¾" x 21" or 30"
Longitudinal Travel (screw or lever)	10" or 19"
Transverse Travel (screw or lever)	7"
Vertical Travel — Knee	13½"
Rise and Fall of Spindle	4½"
Selective Speed Ranges up to 5000 R.P.M.	
Weight	1250 lbs.

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Recuperators

Typical of conditions in many types of heat treating equipment is the combination of hot gas and moderate stress conditions found in recuperator installations. These recuperators are usually installed in waste gas flues, to recover the heat to be used for preheating of air. The waste gases to which the alloy may be exposed will produce every variety of hot gas corrosion. To meet such demands, a heat resistant material of moderate strength, but with high corrosion resistance, is necessary and an alloy from Group A is indicated. For the particular application considered here, strength requirements indicated an alloy of somewhat better mechanical properties than type HC; so type HD was suggested by the Duraloy Company, Scottdale, Pa., which made the castings. This alloy, containing 28% chromium and 5% nickel, can be used for applications where moderate stress is encountered up to 1400° F, and for somewhat lighter load-bearing duties up to 2000° F. Because of the high chromium content, type HD resists oxidation and is especially useful in high sulphur-containing atmospheres. The castings illustrated measure 66" long and 5" to 8" wide, and are installed in recuperator banks varying from four to 40 castings.

Annealing Retorts

A dramatic example of the value of proper alloy selection, and its effect on performance, is provided by the annealing retorts cast and fabricated by the Electro-Alloys Division of the American Brake Shoe Company, Elyria, Ohio. Used to protect high-speed tool steel from combustion products in hood-type furnaces, heated by high sulphur-content anthracite producer gas, these retorts were formerly made of seamless carbon steel tubes. Performance was unsatisfactory.

In the annealing process, the furnaces containing the retorts are preheated to 1650° F and held at this temperature for 10 hours. The temperature is then dropped to 1400° F, held for two hours, dropped to 1375° F and held for three hours, after which the stock and retorts are furnace cooled. The total cycle takes 30 hours.

The tool steel manufacturer followed the advice of Electro-Alloys engineers, who recommended that the new retorts be centrifugally cast of ACI type HH alloy. Containing 24 to 28% chromium and 11 to 14% nickel, this type has high strength, ductility and corrosion resistance at temperatures up to 2000° F. The HH grade can be produced as partially ferritic or wholly austenitic; the ferritic providing highest hot ductility, and the austenitic highest hot strength. The particular composition chosen was an austenitic modification designed for high strength and maximum resistance to embrittlement.

Previous Experience With Carbon Steel Retorts: The processor formerly used 20-foot seamless carbon steel pipes. Average life expectancy for these pipes was 500 cycle-hours, or about 16 passes through the furnace. Replacement was required every eight weeks, primarily because of scaling and flattening or deformation. Severe scaling from the hot gas corrosion diminished the section of the retorts, with consequent loss of strength, greater tendency to breakage, and less uniform annealing.

Because of loss of symmetry, the retorts could not be fully loaded or stacked properly in the furnaces, which resulted in poor economy of operation. In addition, cast iron plugs, designed to seal the ends of the retorts, could no longer be fitted properly after distortion of the pipe. Fire brick and mud were used to seal the open ends of the distorted members — a troublesome and time-consuming job. This type of plugging also failed to provide the gas-tight seal necessary for uniform annealing.

Experience With Cast High Alloy

. . . Continued on page 166

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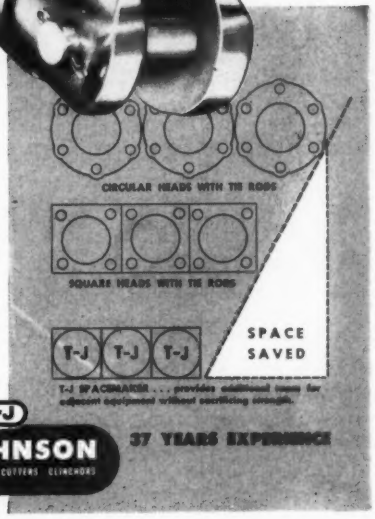
extra high safety factor!

NEW T-J Spacemaker AIR CYLINDERS

These new T-J Cylinders *save up to 40% in mounting space*—with streamlined design that eliminates tie rods. They're *super rugged*—extra high safety factor . . . solid steel heads . . . heavy wall, precision honed, hard chrome plated, seamless steel body . . . leakproof cylinder head to body construction . . . heavy duty, hi-tensile, hard chrome plated piston rod.

Available with the new T-J Super Cushion Flexible Seals which insure positive cushion with automatic valve action for fast return stroke. Many standard sizes and styles . . . for pushing, pulling, lifting, clamping or control jobs. T-J dependability. Write for bulletin 8152. The Tomkins-Johnson Co., Jackson, Mich.



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INFORM-A-GRAM

ADVERTISEMENTS IN OCT., 1953 ISSUE

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2	19	37	77	97	107	124	143A	146E	152B	157B	162C	174	183B	191A	196D	202B
3	20	38	78	98	108	125	143B	147A	153A	157C	162D	175A	185A	191B	197A	202C
4	21	39	79	98.1	109	126	144A	147B	153B	157D	162E	175B	185B	191C	197B	203A
5	22	40	80	98.3	110	127	144B	148A	154A	158A	163A	175C	185C	191D	197C	203B
6	23	41	81	98.4	111	128	144C	148B	154B	158B	163B	175D	187A	192A	198A	203C
7	24	42	82	98.5	112	129	144D	148C	154C	158C	164A	177	187B	192B	198B	205
8	25	44	84	98.6	113	130	145A	148D	154D	159A	164B	178A	187C	192C	198C	206
9	26	45	85	98.7	114	133	145B	149A	154E	159B	164C	178B	187D	192D	199A	
10	27	46	86	98.8	115	134A	145C	149B	155A	159C	164D	179A	187E	193A	199B	
11	28	67	87	99A	116	134B	145D	150A	155B	159D	165A	179B	189A	193B	199C	
12	29	69	88	99B	117	136	145E	150B	155C	160A	165B	179C	189B	193C	200A	
13	30	70	89	100	118	137	145F	150C	155D	160B	166	179D	189C	195A	200B	
14	31	71	90	101	119	138	145G	150D	156A	161A	167	180A	190A	195B	200C	
15	32	73	91	102	120	139	146A	150E	156B	161B	169	180B	190B	195C	201A	
16	34	74	92	104	121	140A	146B	151A	156C	161C	171	181	190C	196A	201B	
17	35	75	93	105	122	140B	146C	151B	156D	162A	172	182	190D	196B	201C	

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4	21	39	79	98.1	109	126	144A	147B	153B	157D	162E	175B	185B	191C	197B	203A
5	22	40	80	98.3	110	127	144B	148A	154A	158A	163A	175C	185C	191D	197C	203B
6	23	41	81	98.4	111	128	144C	148B	154B	158B	163B	175D	187A	192A	198A	203C
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15	32	73	91	102	120	139	146A	150E	156B	161B	169	180B	190B	195C	201A	
16	34	74	92	104	121	140A	146B	151A	156C	161C	171	181	190C	196A	201B	
17	35	75	93	105	122	140B	146C	151B	156D	162A	172	182	190D	196B	201C	

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A1	A15	A29	A43	B5	B19	B33	B47	B61	B75	B89	C7	E6
A2	A16	A30	A44	B6	B20	B34	B48	B62	B76	B90	C8	E7
A3	A17	A31	A45	B7	B21	B35	B49	B63	B77	B91	C9	E8
A4	A18	A32	A46	B8	B22	B36	B50	B64	B78	B92	C10	E9
A5	A19	A33	A47	B9	B23	B37	B51	B65	B79	B93	D1	E10
A6	A20	A34	A48	B10	B24	B38	B52	B66	B80	B94	D2	E11
A7	A21	A35	A49	B11	B25	B39	B53	B67	B81	B95	D3	E12
A8	A22	A36	A50	B12	B26	B40	B54	B68	B82	B96	D4	E13
A9	A23	A37	A51	B13	B27	B41	B55	B69	B83	C1	D5	E14
A10	A24	A38	A52	B14	B28	B42	B56	B70	B84	C2	E1	E15
A11	A25	A39	B1	B15	B29	B43	B57	B71	B85	C3	E2	E16
A12	A26	A40	B2	B16	B30	B44	B58	B72	B86	C4	E3	
A13	A27	A41	B3	B17	B31	B45	B59	B73	B87	C5	E4	
A14	A28	A42	B4	B18	B32	B46	B60	B74	B88	C6	E5	

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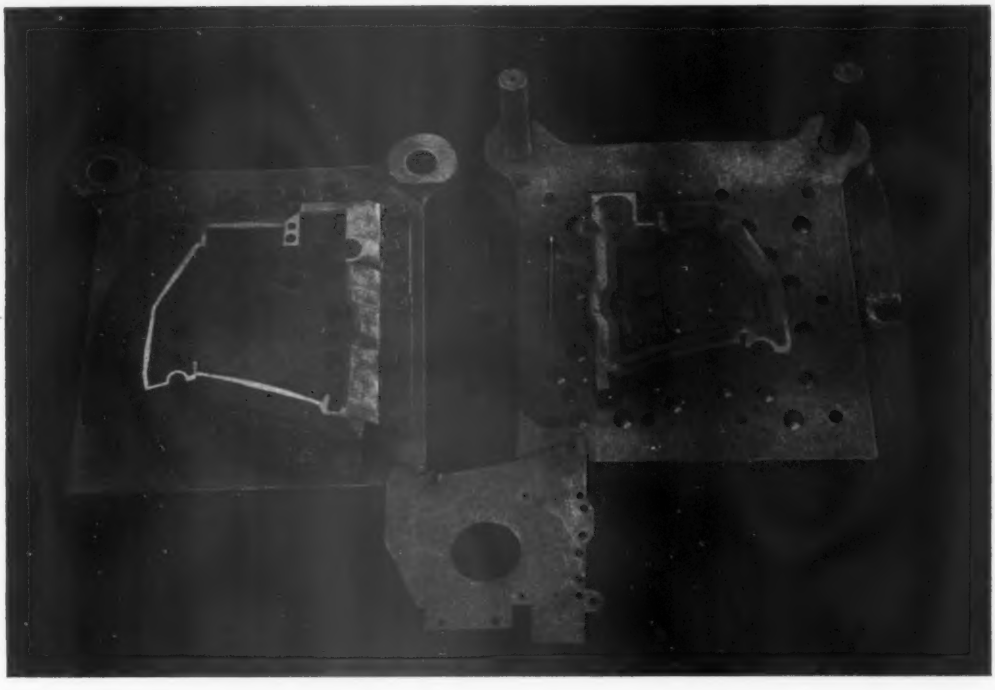


How to *Cut Costs and "Corners"* on Your Blanking Dies

Write for New Booklet:

COMPOSITE DIE SECTIONS

Contains complete data on 35 Standard Die Sections, from combinations of which thousands of die shapes can be made —also full information on Special Die Sections, and how to order.

Get Your Copy— Write for it Today

Address Dept. TP-46

You can save steel and time in the making of dies for blanking, trimming, beading, or any application involving the cutting of sheet metals to regular or irregular shapes, by assembling them from FCC Composite Steel Die Sections.

These prefabricated die parts consist of fine tool steel cutting edges, in a selection of grades, electrically welded by a special process to non-hardenable mild steel bases. Thus, screw and dowel holes may be easily drilled after heat treating, and there are numerous other advantages that will be immediately obvious to the die maker.

Thousands of die shapes may be made up from combinations of thirty-five standard sections. Specially shaped sections are manufactured to customers' specifications in five to ten days.

Make *your* dies this money-saving way. ● *Write Allegheny Ludlum Steel Corporation, Forging & Casting Division, Wanda & Jarvis Aves., Detroit 20, Mich.*

For complete **MODERN** Tooling, call

Allegheny Ludlum

W&D 3667

AL FINE TOOL STEELS SINCE 1854

SEE ADVERTISERS INDEX, BACK OF BOOK, FOR INFORM-A-GRAM KEY NUMBERS

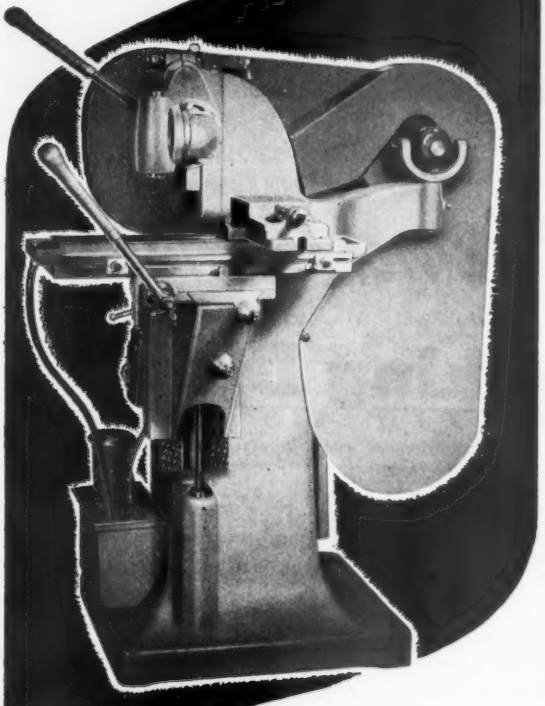
Cut Costs

on Tool Room, Development and Mass Production Milling with

U. S. No. 1

HORIZONTAL MILLING MACHINES

Time-proved, shop-proved, profit-proved "U. S. No. 1" heavy duty, hand-feed milling machines are outstandingly America's No. 1 Machine Tool value. Easily adapted to production with automatic devices.



SEND FOR DATA AND SUGGESTIONS

Suggestions as to how a U. S. No. 1 Milling Machine can cut costs on your particular production needs, as well as complete data on the basic machine and attachments, gladly furnished on request.

THE U. S.-BURKE MACHINE TOOL DIV.
Brotherton Road 7.
Cincinnati 27, Ohio

JOB PROVEN!

SAMSON

offset BORING CHUCKS

precision built by precision toolmakers for accuracy and durability in service!

• Designed for quick tool change; equipped with new, extra large dial for precision radial adjustment; machined to provide positive dead centering for rigid, high production milling and boring without removal of chuck; available with a complete selection of interchangeable accessories—these are features that make the Samson Offset Boring Chuck the logical first-choice of the field.

Write for complete information today

ALSO Distributors of famous LAST WORD WHEEL DRESSERS

LAST WORD sales company
18500 MT. ELLIOTT AVE. • DETROIT 34, MICH.

This engraving, made in 1890, shows Henri Moissan, the French scientist who played an important part in the development of electrical furnaces and their many applications in research and industry. The engraving is on Volume 6, Issue No.

Henri Moissan, 1852 - 1907

POWDER METALLURGY

5 of the Powder Metallurgy Bulletin, published at 320 Yonkers Ave., Yonkers, N. Y. Besides containing information about the noted scientist, this issue of the magazine has a wealth of data on the theory of powder milling processes and an evaluation of molybdenum borides as cutting tools.

Circle Inform-A-Gram No. C1.

"How to Store Coated Abrasives" is the subject of a helpful booklet being distributed by the Coated Abrasive Division of Armour and Co., Alliance, Ohio. Emphasis is placed upon the importance of constant relative humidity to prevent the deterioration of abrasives. Controlled temperature and circulating air are also discussed. Added is a section describing Armour abrasive discs, sheets, rolls and belts.

Circle Inform-A-Gram No. C2.

An Efficient High Speed Steel called Electrite Double-Six M-2, is the subject of a brochure available from the Latrobe Steel Co., Latrobe, Pa. This booklet concerns itself with the uses of this "Desegatized" high speed steel, plus other general information on forging, tempering, and various recommendations for working. A tempering data sheet also is included in the booklet.

Circle Inform-A-Gram No. C3.

A PREHEAT CALCULATOR, using the slide rule principle to quickly determine preheat temperature required when welding hardenable steels, has been brought up to date and is being re-issued by the Lincoln Electric Co., 22801 St. Clair Ave., Cleveland 17, Ohio. The price of this calculator is 50 cents in the U.S.A. and 75 cents elsewhere.

HARDNESS CONVERSION CHART

Approximate conversions from the Rockwell scale to the Shore Scleroscope, Vickers or Brinnell systems for heat-treated steel, unhardened steel, cast iron and non-ferrous metals are shown in a handy wall chart developed by the Clark Instrument Co., 10200 Ford Rd., Dearborn, Mich.

Circle Inform-A-Gram No. C4.

FABRICATORS OF TUBULAR MATERIALS will benefit by a new reference table designed by the Tubular Products Division of Babcock and Wilcox Co., Beavers Falls, Pa. The table outlines pertinent details in joining similar and dissimilar alloys by arc welding.

Circle Inform-A-Gram No. C5.

MEASURING INSTRUMENTS

Alina Corp., 401 Broadway, New York 13, N. Y., has prepared a new 37-page handsomely illustrated catalog of Etalon stainless steel measur-

ing instruments. Book also includes detailed instructions on measurement with the vernier caliper and a handy chart showing decimal and millimeter equivalents of fractional parts of an inch.

Circle Inform-A-Gram No. C6.

FROM ONE MACHINIST TO ANOTHER

HOW TO MACHINE
MYCALEX GLASS-BONDED MICA

A comprehensive 23-page, illustrated reference and operation manual on the machining of glass-bonded mica has been issued by Mycalex Corp. of America, Clifton Blvd., Clifton, N. J. The booklet shows how to machine Mycalex glass-bonded mica. It is divided into 4 parts: the general picture, "do's and don'ts," trouble you will have and how to perform specific machining operations.

Circle Inform-A-Gram No. C7.

MAKE GAGES LAST LONGER. Size Control Co., 2500 W. Washington Blvd., Chicago 12, Ill., is offering a handy chart on what to do and what not to do to preserve your gages. Copies are available on heavy-coated stock for posting in inspection departments and gage laboratories free of charge.

Circle Inform-A-Gram No. C8.

Motion Pictures for Training Lathe Operators are described in Bulletin 5230, printed by the South Bend Lathe Works, 425 East Madison St., South Bend 22, Ind. Three 16 mm sound films in full color are supplied on free loan to industrial firms, educational institutions and the armed forces. Sound tracks also are available in French and Spanish. The films introduce a lathe to the "beginner," shows how to machine a shaft and the correct way to grind tools for different lathe operations.

Circle Inform-A-Gram No. C9.

"FUNDAMENTALS OF STEEL CASTING DESIGN" is the title of a booklet being offered by Steel Founders' Society of America, 920 Midland Bldg., Cleveland 15, Ohio. Why engineers and designers should be concerned with steel casting design is the question taken up in this booklet.

Circle Inform-A-Gram No. C10.

Double End Boring, Chamfering and Centering Machines Produce Over 6,000 Pieces Per Hour

A new line of double end machines ideally adapted to boring, chamfering, centering, burring, milling, flaring and spinning operations has just been announced by a Detroit company of designers and builders of special machinery. These machines are available in a variety of sizes to suit individual customer requirements.

Extremely high production rates in excess of 6,000 pieces per hour are the result of a hydraulic powered magazine feed arrangement and unique motorized heads equipped with hydraulic feeds. Spindles in these heads resist unbalanced thrust loads up to 14,000 pounds.

Machine Operation

Work pieces requiring machining operations on both ends are loaded in the magazine. They are fed one at a time and chucked in a stationary position for machining by the action of a hydraulic cylinder mounted at the rear of the machine and equipped with controlling fingers and chuck jaws at each end of the work holding fixture. No springs are used in the guiding mechanism to position and handle the part. Two air cylinders at each end of the fixture act in conjunction with the hydraulic cylinder to provide uniform tension throughout loading and unloading. The power heads rest on flat ways on the machine bed and are adjusted to a position to suit the length of the part being machined.

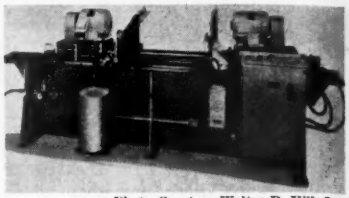


Photo Courtesy Walter P. Hill, Inc.

When a work piece is positioned between the magazine guides, the cutter spindles are automatically positioned to compensate for part length variations and are hydraulically fed to the specified depth and retracted. Then the finished part is ejected into a box or basket by the exhaust of the air cylinders as a new part drops in position, thus completing the work cycle. Adjustable stops control the travel of the cutter spindles.

Unique Power Heads

Spindles in the power heads are supported in a 14-in. long sleeve by tapered roller bearings. This steel sleeve is a ground fit to the honed cast Meehanite head. Hydraulic cylinders at the rear of each head control the feed of the spindles through guide rods attached to the front of the spindle sleeve. The spindle is driven by a splined-hole V-belt pulley and adapter assembly mounted in the Meehanite head with two ball bearings. A sliding spline fit is provided between the spindle end and the V-belt pulley adapter. Thus, as the spindle advances, maximum radial stability is assured.

Machine Specifications

The machine illustrated

TO GEAR MANUFACTURERS Exclusively

if you have trouble meeting production schedules.

if you have trouble meeting precision tolerance specifications.

YOU should "read-up" on the HAMILTON® line of Small-Gear, Precision Hobbing Machines!

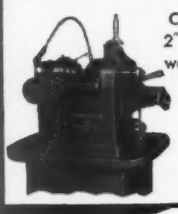
3

THREE PRECISION MACHINES to meet your every requirement.

HAMILTON No. 00

For the generation of spur gears and pinions only.

Capacity: 2" O.D. of workpiece.



HAMILTON No. 1

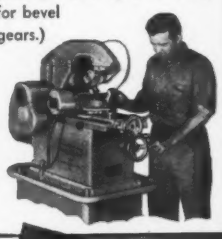
Hobs spur and spiral gears, worm gears and worms (to three thread), splined shafts, gear sectors, and pinions.

Capacity: 6" O.D. of workpiece.

HAMILTON No. 1-B

Generates any shape that can be made on the No. 00 or the No. 1 machines, *plus* bevel gears and face gears.

Capacity: 6" O.D. of workpiece (3" O.D. by 3/16" face, for bevel gears.)



Exclusive Greater range of hob spindle speeds: 109 to 1259 R.P.M. — 12 speeds.

Exclusive Speed, feed, indexing. *Each can be selected independently.* This, and wide range of hob speeds, adds flexibility; reduces set-up time; gives quick selection of speed and feed to suit material and gear size.

Exclusive Alignment and trueness of work and hob spindles are held to within .0002".

Exclusive Generates gears from 3 teeth to 1200 teeth.

Exclusive Accumulative error of not more than .0002" guaranteed.

THE COMPLETE STORY will be sent to you free for the asking. Request BULLETIN GH-5310 DO IT NOW!

THE Hamilton TOOL COMPANY

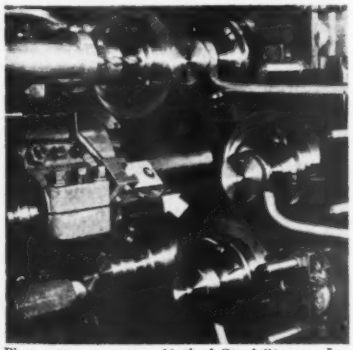
832 SO. NINTH STREET • HAMILTON • OHIO • U • S • A

chamfers both ID and OD, and faces both ends of 3/16 to 5/8 in. diameter metal tubing from 3 to 40 inches long. Length adjustment is automatic for a given size tube. Interchangeable clamp jaws are provided for various tube diameters. An inserted blade combination tool is mounted in each spindle. Production rate is in excess of 6,000 pieces per hour.

This double end machine has a welded steel base and is 12-ft. long, 2-ft. deep and 4-1/2-ft. high. 3-hp. motors power each head. Pushbutton controls on top of the electrical panel at the front of the machine control the automatic machine cycle. A separate hydraulic power pact unit having a 12-gpm, 1000-psi pump, 10-hp. motor, and 40-gal. tank provides power for the spindle feed. An air accumulator tank for the work feed mechanism air cylinders is mounted at the front of the machine. The cutter spindle travel is adjustable up to 6 inches.

End of Thin-Flanged Parts Marked During Automatic Screw Machine Cycle

A manual marking operation was eliminated in the production of a thin-flanged service part for Ford Motor Company by installing an automatic marking device in the tailstock of this Conomatic 6-spindle automatic screw machine at station 5, Figure 1. The marking device, recently developed, advances, stamps a trade mark and identification numbers, retracts and automatically resets ready for the next part—all during the machine cycle.



Photos Courtesy New Method Steel Stamps, Inc.

Fig. 1 Trade mark and identification numbers are stamped on the end face of Ford service parts during the cycle of this 6-spindle Conomatic by using an automatic marking device recently developed. This avoided a secondary marking operation since marking was not desired on the outer surface of the thin flange.

For Your Future
U. S.
SAVINGS BONDS

A total of six job lots of 6,900 parts each were marked with different identification numbers with a single marking unit by interchanging standard roll dies at the end of each production run. Selection of marking radius for each lot was made possible by the adjustable roll die holder head which is mounted on dovetailed ways, Figure 2.

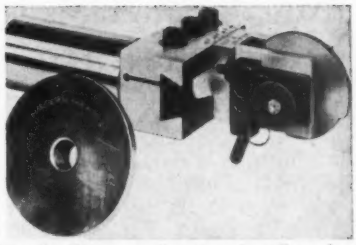


Fig. 2 Close-up of automatic roll marker for end face parts marking and Ford service part showing 19-character marking.

THE HAMILTON
PORTELVATOR®
(Portable Elevating Table)
MAKES IT Easy TO LIFT • LOWER LEVEL • TRANSPORT LOADS UP TO 5,000 lbs.

3 TABLE SURFACES
Can be worked at from ALL 4 SIDES
Slow or fast lift.
Self locking at any height.
4 POINT SUPPORT
(table can't tip)
Lift mechanism can be operated from either end.
Turns easily on anti-friction casters. Positive floor lock.
WELDED CONSTRUCTION
Mechanical lift through worm, worm gear and screw.
TABLE CAN'T SETTLE

STYLE "A" (Illustrated)*
Max. Height 40" Min. Height 25" Length 33" Width 21" Weight 225 lbs.
Capacity 2,000 lbs. (plus safety factor)
FURNISHED ON ORDER
SAF-T-RAIL — Guard rail fits either top or middle table.
ROLLER CONVEYOR TOP • RUBBER TIRED WHEELS
*THREE STANDARD MODELS TO CHOOSE FROM

GET THE DETAILS WRITE FOR BULLETIN P-5247

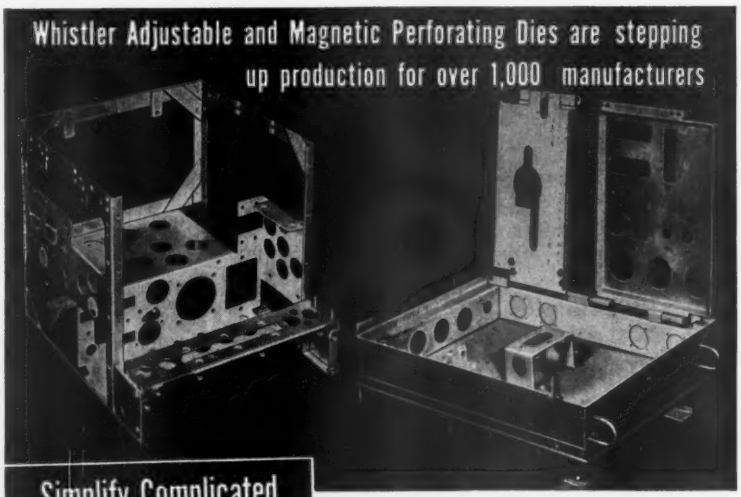
THE Hamilton TOOL COMPANY
832 SO. NINTH STREET • HAMILTON • OHIO • U • S • A

New Reamer Sizes by Whitman & Barnes

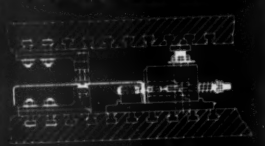
Whitman & Barnes, Plymouth, Michigan, has recently added new sizes to its regular line of Straight Shank, Straight Flute and Straight Shank Spiral Flute Chucking Reamers. In the Straight Flute type, the following sizes will now be considered standard items:

Fractional Sizes — All 64th sizes from 3/64" thru 31/64"
Wire Gauge Sizes — #1 to #60, inclusive
Letter Sizes — A to Z, inclusive

Decimal Sizes—.124" .126" .1865" .1885" .249" .251" .3115" .3135" .374" .376" .4365" .4385" .499" .501"
Spiral Flute Type—All 64th sizes from 5/64" thru 31/64"



Simplify Complicated Piercing Operations



Use this HU-50 90° Perforating Unit on the same job with other Whistler Dies . . . often saves extra press operations.

USE WHISTLER Adjustable and Magnetic Dies for perforating, notching and slotting sheet metals... fast, accurate and cost cutting. Complicated patterns can be set up quickly. Hole arrangements can be changed in the press... without waiting and at no extra die cost. New HU-50 units, that pierce at 90° angle, can be used in conjunction with standard perforating equipment. Fewer press operations are necessary.

Re-use the same dies in different arrangements on many jobs. Punches and dies are interchangeable.

Whistler Adjustable Dies can be used in practically every type press. Standard sizes and shapes of punches and dies available up to 3 inches. Special sizes and shapes to order.

S. B. WHISTLER & SONS, Inc.

748 Military Road
Buffalo 23, New York

For prices and application data on this modern way to speed production and cut unit costs, write for these illustrated Whistler catalogs.

For your convenience **, Whistler direct factory representatives are located in most principal cities. Their on-the-job application experience, combined with Whistler's 35 years experience in the manufacture of tools and dies, is available on request.**

Booth 2024 — National Metal Congress — Oct. 19 to 23, Cleveland

Carbide Ratchets Help Reduce Saw Production Costs

Substantial savings in equipment costs in addition to elimination of much down time for changing machine components were recently secured at Henry G. Thompson & Son's New England plant by switching from an oil-hardened tool steel feed ratchet to one made of solid tungsten carbide.

Operators of the above plant, famous for the manufacture of quality profile, band and hack

Photo Courtesy Kennametal Inc.

Kennametal feed ratchet 1" dia., 10 pitch, to date has outlasted 60 oil-hardened tool steel ratchets which were previously used for feeding band saw stock through teeth setting dies.

Maximum life of steel ratchet which costs $35.00 each was 100,000 feet of stock. At time of last report the Kennametal ratchet had fed 6,000,000 feet and was still in good condition.

The Kennametal ratchet which cost $88.22 (blank plus grinding by local tool maker) has already saved user $2011.78 in ratchet cost alone.

saw blades, have reported that their 1-inch diameter, 10-pitch Kennametel carbide ratchet is outlasting more than 60 of its tool steel contemporaries.

Briefly, Thompson's operation is as follows: Band-saw stock is fed at a per-set rate by means of a ratchet through Kennametal carbide setting dies which produce the desire set in the saw teeth. Steel stock is payed-off one reel in a vertical position with teeth up, through the setting dies, and onto a take-up reel. The feed ratchet—driven through a gear train—is synchronized with the setting die to assure the proper feed cycle for a correct saw tooth set.

Since the ratchet maintains continuous contact with the steel saw stock, any excessive wear on

. . . Continued on page 167

Automation Boosts Production of Shoulder Gears to 240 Per Hour

Basic Machine is Standard "Underpass" Shaver

Even a 6.250-inch flange doesn't slow up production of automotive shoulder gears on an automation equipped "Underpass" gear shaver. One shaved helical shoulder gear every 15 seconds is the pace maintained by this conveyorized setup with fully automatic operation.

The basic machine, Figure 1, is a Model 870 "Underpass" gear shaver built by a Detroit manufacturer and tooled up for fully automatic operation. All the operator has to do is load the hopper; the rest of the cycle, including pre-inspection of gears, is automatic.

A sizing fixture at the hopper mouth rejects oversize gears, thus providing automatic quality control through the operation.

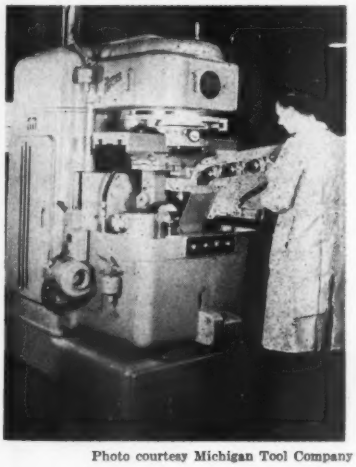


Photo courtesy Michigan Tool Company

Fig. 1. Operator loads hopper of "Underpass" Gear Finisher with shoulder gears. From this point on all steps including pre-inspection and rejection of oversized gears are automatic.

Gears move down the trough by gravity, Figure 2, until they reach the loading position. Here an air cylinder takes over and feeds the gears into shaving position, one at a time. The shoulder of the incoming gear pushes against the shoulder of the shaved gear, causing the latter to eject at the completion of the shaving cycle. The gear teeth themselves never touch, so there isn't any possibility of damage to the finished gear.

An air-operated expanding mandrel clamps the incoming gear and holds it during "Underpass" shaving (the fastest known precision shaving method).

Positioning of the gears is apparently so positive that a safety device, provided for automatically ejecting any gear not properly aligned with cutters, has not come into operation at any time during production test runs. Release at the end of the machine cycle is automatic. The 27-tooth helical gears have a 2.0257-inch

. . . *Continued on page 165*

MÄGERLE HYDRAULIC SURFACE GRINDERS

AUTOMATIC DOWN FEED
•
AUTOMATIC FINISH SIZING

A work measuring instrument reveals the difference between work size and required final size during the grinding operation . . . The automatic feeding and sizing is powered by a separate electrical unit . . . The machine requires no attendance during the grinding operation

Finishes within .0002 on repeated chuck loadings automatically . . . Rapid traverse is provided for both head and cross slide . . . Extremely rugged construction and very easy to operate . . . Available in 2 foot, 3 foot and 4 foot models . . .

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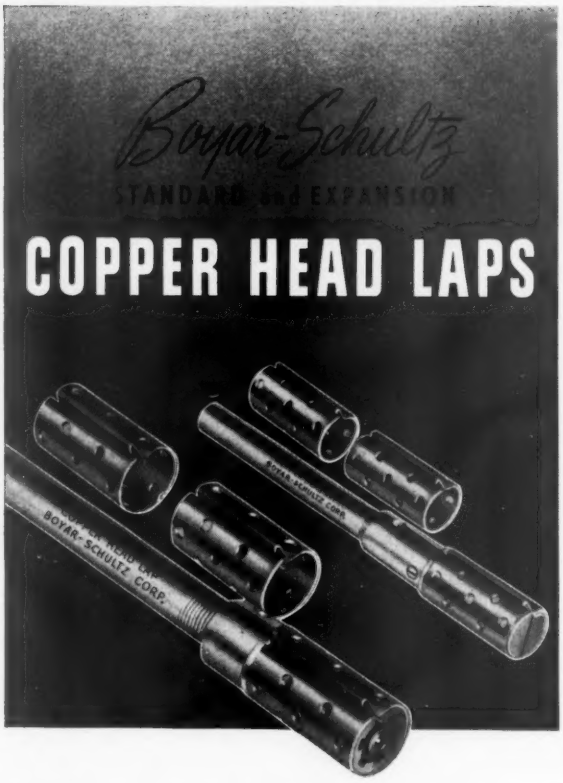
13500 FOLEY AVENUE • DETROIT 27, MICHIGAN



BOYAR-SCHULTZ COPPER HEAD LAPS are accurate, fast working and easy to use. They are much less costly than making laps in your own tool room. Because the only wearing part is the inexpensive copper sleeve, they are long lasting.

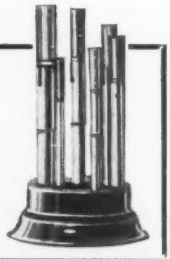
Unlike laps made for specific jobs, they are used over and over again, changing only the sleeves. Adjustment permits correct lapping size to be maintained till sleeve is worn out and replaced with a new one. Thus, with Boyar-Schultz Copper Head Laps you save tool room time and get accurate speedy lapping.

Copper Head Laps and Sleeves are immediately available from stock, in standard sizes—⅛" to 2½" diameters.

Write for descriptive circular

SPECIAL TOOL MAKERS BENCH LAP SETS

A time saving set in Tool & Die work. Set consists of seven most commonly used sizes - ⅛" - 3/16" - ¼" - 5/16" - ⅜" - 7/16" - ½", with enameled die cast base.

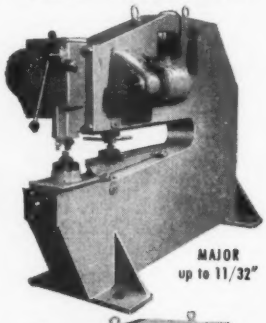


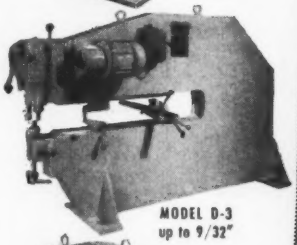
BOYAR-SCHULTZ CORPORATION
2112 Walnut Street Chicago 12, Illinois

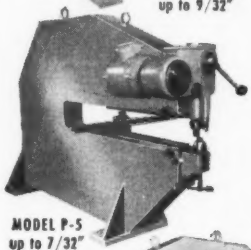
PULLMAX
does all these operations

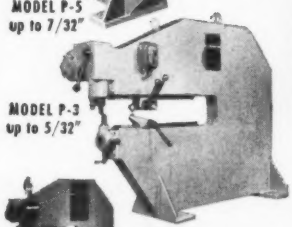
Save time, labor and expensive dies. Choice of 9 sizes and capacities to work from 16 ga. up to 11/32" thicknesses. Quick changing attachments. Works all steel and non-ferrous metal.

ALL OF THESE PULLMAX MACHINES . . .

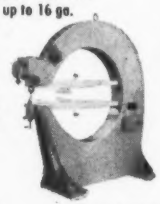

MAJOR up to 11/32"


MODEL D-3 up to 9/32"


MODEL P-5 up to 7/32"


MODEL P-3 up to 5/32"

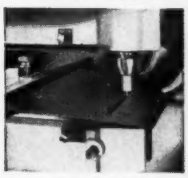
MODEL AM & AL up to 16 ga.

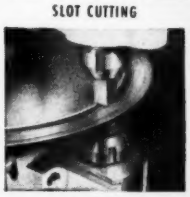

Pullmax Trimmer for trimming excess metal from bulky stampings up to 5/32".

DO ALL OF THESE OPERATIONS

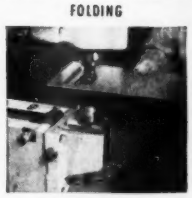
CIRCLE CUTTING

STRAIGHT CUTTING


SLOT CUTTING


BEADING

FOLDING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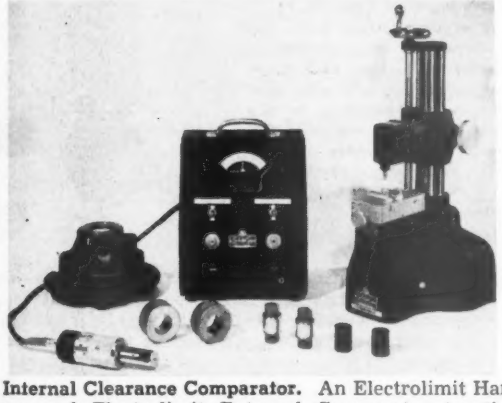
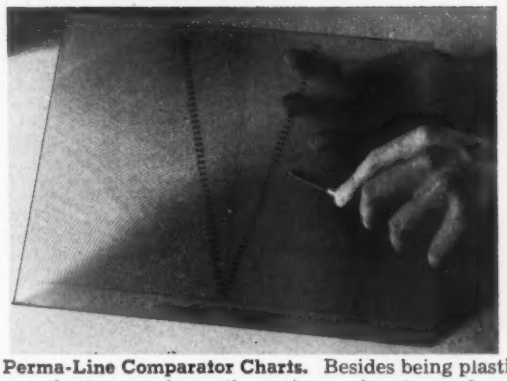
This Month: Featuring QUALITY CONTROL Tools and Products

Precision Flat Lapping Machine. This machine was developed to provide a low cost tool for producing superfine micro-inch finishes. It is precision built for quickly finishing such parts as gages, sliding and rotating parts, air and liquid tight seals and valves. On this machine, made by the Spitfire Tool Co., 2931 N. Pulaska Rd., Chicago 41, Ill., it is possible to obtain finishes as fine as 2 rm micro-inches where extremely critical and precise flat surfaces are required. No set-ups, collets, chucks or holders are needed; yet the lapping machine can be adapted to automatic fine surface finishing for rapid processing of parts.
Circle No. A1.



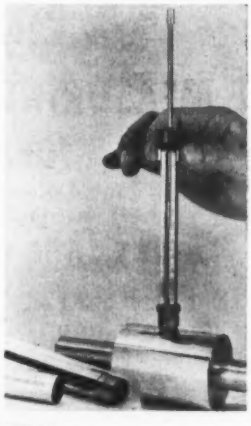
Internal Clearance Comparator. An Electrolimit Hand Gage and Electrolimit External Comparator together with a DOU meter has been combined to form the Radial Internal clearance comparator now being produced by Pratt & Whitney's Division Niles-Bement-Pond Co., W. Hartford, Conn. The gage shows the actual clearance between parts being checked. **Circle No. A2.**

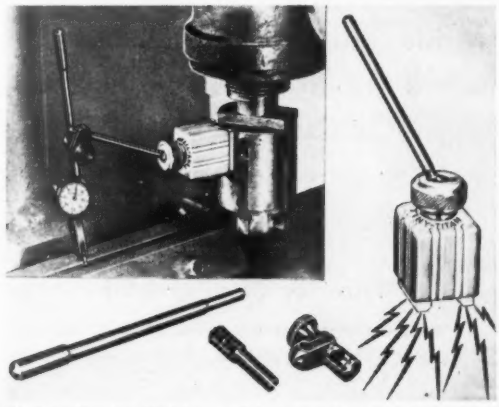
Magnetic Base Indicator Holders. Made by the Lufkin Rule Co., Saginaw, Mich., they eliminate cumbersome, haphazard clamping—speed up the job and give greater accuracy. Just place the indicator holder against any round or flat iron or steel surface and the permanent magnet attaches at once. The holder is ideal for nearly all dial indicators on lathes, shapers, mills and planers. The swivel action post can be quickly and firmly secured in position with knurled locknut. A sensitive friction joint gives accurate adjustments. Free literature available.
Circle No. A3.



Perma-Line Comparator Charts. Besides being plastic, these chart-gages have the unique advantage of permanent chart lines. The specially processed lines are on 0.050" thick Vinylite. The makers of the Perma-Line charts, Optical Gaging Products, Inc., 26 Forbes St., Rochester 11, N. Y., will happily furnish further information upon request. **Circle Inform-A-Gram No. A4.**

Pocket-Size Hardness Tester. These testers, known as Sklerografs, are specifically designed for on-the-spot testing. They operate on the rebound principle and combine low cost with simplicity of use. The testers come with tubular nickel containers for easy carrying on the job. They are being distributed in the U. S. by Kurt Orban Co., Inc., 205 E. 42nd St., New York 17, N. Y. Two models are available. Model M weighs only 5¼ ounces, including container. Model D is somewhat larger and weighs 9 ounces with container. **Circle No. A5.**





Dial Indicator Holder. This is a magnetic base indicator holder which can be mounted instantly to flat or round surfaces down to ¾" in diameter with a pull of 65 pounds. The tool is a product of the Enco Mfg. Co., 4520 W. Fullerton Ave., Chicago 39, Ill.
Circle Inform-A-Gram No. A6.

SEE ADVERTISERS INDEX, BACK OF BOOK, FOR INFORM-A-GRAM KEY NUMBERS

WELDON

MEASURING ATTACHMENT

for Lathes

(Direct Reading)

Saves Time • Reduces Waste

• This handy Weldon attachment measures directly the forward or reverse movement of the lathe carriage, within .001 of an inch. Easily attached to most lathes by drilling and tapping of one hole. • Dependable, accurate, convenient . . . saves time and reduces work spoilage.

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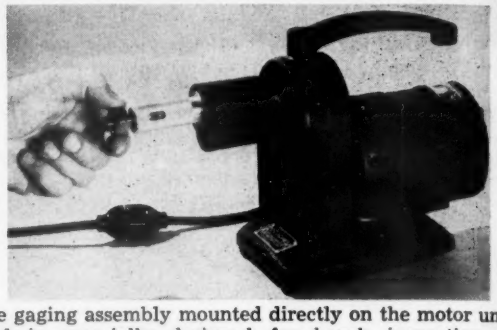
Weldon distributors throughout U. S. A. and Canada carry complete stocks to serve you.

THE WELDON TOOL COMPANY

3000 WOODHILL ROAD · · · CLEVELAND 4, OHIO

Power Thread Gaging Unit. This is an electrically operated gage for checking internal threads by power instead of by manual rotation. The bench model has



the gaging assembly mounted directly on the motor unit and is especially designed for bench inspection of threaded products. The gaging unit is made by the Taft-Pierce Mfg. Co., Woonsocket, R. I.
Circle Inform-A-Gram No. A7.

AMPLIFYING GAGE. Both optical and mechanical principles are combined in this new instrument that is sensitive and precise for fine gage and tool work. The gage, on the other hand, can be used for rugged day in and day out production inspection. Called the Leitz Opti-Comparitol, the gage is imported from Germany by the George Scherr Co., Inc., 200 Lafayette St., New York 12, N. Y. Over or under sized parts can be discovered in a matter of minutes with this new gage. The instrument will give uniform repeat readings in the hands of skilled or unskilled labor. The diameter capacity is 6". A variety of anvils, contact tips, back stops, etc., are available.

Inform-A-Gram No. A8.

Ultrasonic Measuring Instrument. This new Model MS-101 Ultrasonic Metroscope is particularly useful where wall thickness measurements or tests must be made from one side of the material only, as in the forming or con-

struction of propeller blades, tanks, pressure vessels and cylinders. The instrument is also capable of finding internal defects of a laminar type in sheet materials and imperfect bonds between clad metals, switch contacts, bearing linings, cutting tools, etc. For further details write to the J. W. Dice Co., 1 Engle St., Englewood, N. J.
Circle Inform-A-Gram No. A9.

JIG GRINDING ACCURACY *guaranteed**

INFINITE CONTROLLED SPEEDS 30,000 TO 65,000 R. P. M.

Easily connect jig grinder to jig borer or mill

Then you can finish grind in hardened steel to "tenths" . . . jig grind dowel holes square with a ground base . . . move location of holes in hardened steel blocks . . . jig grind interchangeable holes in hardened sections . . . grind small holes with diamond impregnated mandrels . . . grind contours and relief with tungsten carbide burrs . . . grind radii in die sections . . . eliminate jig bushings in tools where close spacing is essential.

Other infinitely controlled air driven spindle applications

Place spindle on most any machine. Use it for finishing contours on hardened steel working surfaces . . . burring or milling die castings . . . routing wood contours . . . carbide milling or finishing slots . . . finishing holes in hardened steel to "tenths" . . . grinding with diamond wheels, carbide burrs, or diamond impregnated mandrels.

Advantages—10 micro finishes using carbide mills . . . 6 micro finishes using mounted points, operates at any angle . . . air driven, air cooled, overheating prevented . . . speed controlled at optimum point . . . 3⅜" long motor uses little working space . . . By controlling speed at any point you abolish need for many constant speed spindles.

For immediate quotation please state machine tool application. Get this manual of photos showing operations Vulcanaire performs.

*Dependably accurate to "tenths"

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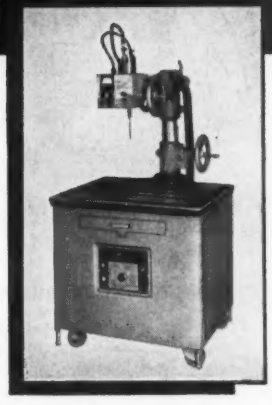
and what it can do for you

Remove broken taps fast without distortion

Cut any shape hole in cemented carbides

Cut dovetails in hardened dies

Cut oil holes in hardened gears without annealing



Literally hundreds of thousands of dollars are saved annually by corporations that are using Metalmasters in just tool and die repair alone.

There's a technical engineer in your area to give you an on-the-spot demonstration in your own plant at your convenience. (NOTE: It is not uncommon to pay for a Metalmaster with just one short demonstration through savings on workpieces.)

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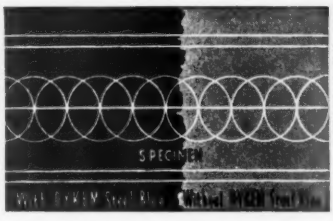

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BLACK GRANITE SURFACE PLATES

Present an absolute continuous bearing surface, finished up to 50 millionths inch. Incredibly smooth. Falling objects do not cause humps. Being harder than hardened steel, can take greatest mistreatment without causing inaccuracy of surface. No oiling. Will not rust or warp. No re-scraping. Most durable.

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PERFECT PRECISION

Avoid substitutes

Immediate delivery in most sizes from 9x12 to 48x144.

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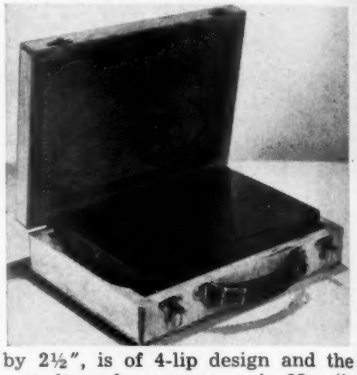
Specify DESTACO **Arbor Spacers and Shims**

For milling, slitting and gang-saw setups, shimming gears and bearings. Sets in 20 diameters ⅜" to 4" . . . 19 graduated thicknesses .001" to .125", specials over .125". Spacers with keyways, shims without. Stocked by Industrial Distributors.

DESTACO DETROIT STAMPING COMPANY

344 MIDLAND AVENUE • DETROIT 3, MICHIGAN

This Ultra-Flat Portable Surface Plate, designed by the Elkro Co., 738 Albany St., Dayton 8, Ohio, is made for accuracy and at the same time mobility. The plate, 8" by 12"

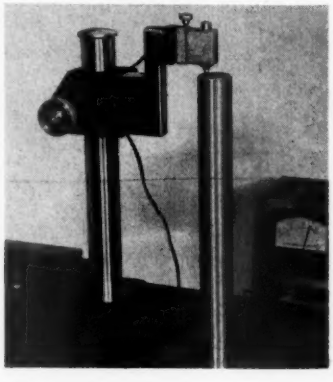


by 2½", is of 4-lip design and the overall surface accuracy is 25 millionths of an inch. The plate and case together weigh only slightly more than 20 pounds.

Circle Inform-A-Gram No. A10.

PAR-AC INSPECTION SET-UP. These two photos show the new bracket developed by the Cleveland Instrument Co., 735 Carnegie Ave., Cleveland 15, Ohio, for its stand-and-anvil type Par-Ac Electronic Production gage. The top picture shows a sine bar setup being checked with the Indi-Ac head on the adapter bracket. The bracket is attached in "low" position. The bottom photo depicts the height of a long cylindrical part being checked with the Par-Ac gage head attached to the adapter bracket which is attached to saddle in "high" position.

Circle Inform-A-Gram No. A11.



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A SPECIALIZED CAM MILLING SERVICE... JIG BORING... SPOT WELDING... CONTRACT PRODUCTION ... EXPERIMENTAL DEVELOPMENT
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Done to your specifications
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has been done with the
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since 1907
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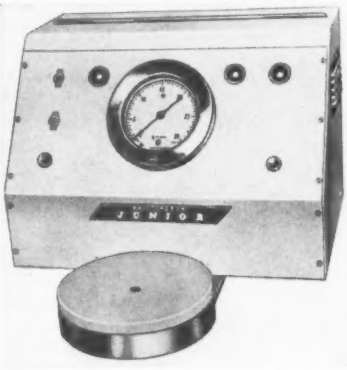
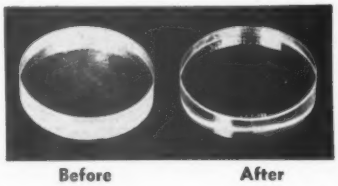
OK T-slot Bolts
The world's best . . . one-piece, drop-forged—not welded—of mild carbon steel, heat-treated, with head accurately milled for standard tables on lathes, planers, boring mills, milling machines. Integral washer and nut. Sizes: up to 30". Typical direct prices for 10" lengths: ½ — $1.36; ⅝ — $1.36; ¾ — $1.58; ⅞ — $1.89. Write for price list
THE O K TOOL COMPANY, INC., Milford 8, N. H.

Vacuum Leak Detectors. A new series of Junior Vacuum Leak Detectors has been added to the line of vacuum testing equipment produced by the Whittington Pump & Engineering Corp., 1126 Prospect St., Indianapolis 3, Ind. Small parts such as castings, weldments and assemblies can be tested on this equipment. **Inform-A-Gram No. A12.**





Before After

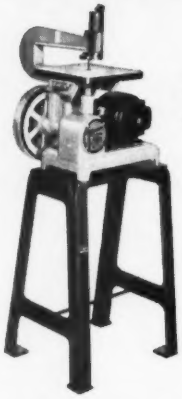
OPTICAL FLATS. Acme Scientific Co., 1450 W. Randolph St., Chicago 7, Ill., has announced a rehabilitation service which restores worn and scratched optical flats to original transparency. No. A13.

Adjustable Protractor. Any number of angles, from zero to 180° can be drawn instantly without turning, sliding or moving the protractor out of position at anytime. A magnifier, built in over the registration mark, gives clear, hairline adjustment. In addition, usually forgotten but often needed mathematical formulae are printed on the reverse side of the calibrated dial. A handy 5" rule on the lower arm is an added convenience. For further information write to Way-Mac Mfg. Co., 8112 Melrose Ave., Los Angeles 46, Calif.
Circle Inform-A-Gram No. A14.

SPECIFY KASSON PRECISION COLLETS AND ATTACHMENTS
IMMEDIATE DELIVERY FROM STOCK
3AT, 3C 1A, 4C 5C
KLUTCH-KOLLET
Step collet for accurate chucking to 2¾" dia. Soft head for easy boring. Lowest price on market! Models 3AT, 3C, 5C.
480 (AC-50)
All collets in hexagon, square and round.
FOR ATLAS • LOGAN • SOUTH BEND CRAFTSMAN • SHELDON LATHES, ETC.
LEVER-TYPE DRAWBAR ½" cap.
Positive grip on undersize, oversize or standard diameter work! Patented coordinate cams eliminate fingers.
Let us quote on your quantity orders for any type of collet, live center or other machine tool attachment!
HAND DRAWBAR ½" cap.
LIVE CENTER (Ball Bearing) Double sealed for accuracy.
KASSON Precision
KASSON Precision products are guaranteed unconditionally for accuracy, fit and long life. Your dealer should have them . . . Write us for literature!
GENERAL DIE AND STAMPING CO.
Integrity Since 1919
264 MOTT STREET • NEW YORK 12, N. Y.

For 30 Years EXPERTS AT STAMPINGS IN SMALL LOTS SHORT RUNS
DAYTON ROGERS Manufacturing Company
Minneapolis 7, Minnesota
New York City, Chicago, St. Louis, Denver, Cleveland, Baltimore, Pittsburgh, Milwaukee, San Francisco, Indianapolis, Detroit, Mich.; Dayton, Ohio; Rochester, N. Y.; Grand Rapids, Mich.; Newton, Mass.

CUT TOOL AND DIE-MAKING COSTS WITH . . .
Milwaukee
DIE FILERS
PROFILE GRINDERS



DIE FILERS
. . . for straight-line sharp corner filing, sawing and lapping

This low cost precision-built unit performs all die making operations at savings up to 40%. Furnished complete with motor and two overarms. No extras to buy.

Write for illustrated Bulletins and Prices

PROFILE GRINDERS
. . . for high speed Precision Grinding of curved and Irregular Contours

Standard features include 20,000 or 30,000 R.P.M., or a combination of these spindle speeds, ½ H.P. motor, Collet Chuck, Compound tilting table, built-in wheel dresser.

RICE PUMP & MACHINE COMPANY
228 Park Avenue Belgium, Wisconsin

AT LAST!
A Low-Priced Dial Type Test Indicator

Contact can be instantly changed. Double faced. Simultaneous reading front and back.
Double faced dial indicator complete with plated holder including 1/32" and 1/8" contacts—
Black Pentrate ...$6.95
Satin Chrome 7.95
1/32" Contact, 1/2" long extension ..... .75

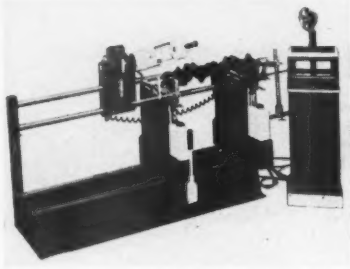
SUPERIOR INDICATOR CO.
P.O. Box 734 Rochester 3, N. Y.

NEW NESTING TYPE
TOTE PANS

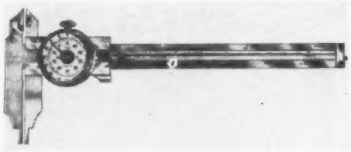
Sturdy 16 ga. metal. 20" long x 12" wide x 6¼" deep. Drag holes and handles at both ends.

J. L. LUCAS & SON, INC.
Bridgeport 5, Conn.

Electronic Industrial Balancer. Because of its quick set up and extreme range, this balancer is ideal for the production line, maintenance or experimental work. It eliminates vibration, thereby increasing speeds.



High speed milling heads, cutters and grinding wheels may be precision balanced to eliminate marks due to vibration also. For further information write to Merrill Engineering Laboratories, Dept. 33A, 1240 Lincoln, Denver, Colo. **Circle No. A15.**



A PRACTICAL CALIPER. The outstanding feature of this 9" by 3 9/16" caliper is the quick, easy and accurate reading of the measurements on the dial. Distributed by the Charles H. Brown Co., Inc., 82 Beaver St., New York 5, N. Y., the instrument is made of stainless steel. Circle Inform-A-Gram No. A16.

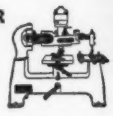
Multiple Gage. Five bearing diameters on a drive shaft can be inspected simultaneously on a multiple gage developed by the Sheffield Corp., Dayton, Ohio. The "Multichek" indicates by means of

lights whether or not the dimensions are within tolerance, oversize or undersize. Shafts can be inspected on this precision instrument at a rate of 600 to 800 per hour at 100% efficiency.

Circle Inform-A-Gram No. A17.

ENGRAVING, ACID ETCHING, ELECTRIC MARKING— all can be done in this PREIS-PANTO UE MACHINE with simple attachments.

MODEL UE ENGRAVER
For metals, plastics and other materials. Electric marks or acid etches hardened steel.



Model CG CUTTER GRINDER
for single-lip Engraving & Routing Cutter Grinding.

PANTO MASTER COPY TYPE

carried in stock

CUTTERS and COLLETS
Single lip, straight or tapered.

PANTO Write for literature.

H. P. PREIS ENGRAVING MACHINE CO.
647 U. S. Route 22, Hillside, N. J.

Over 85% of the torque wrenches used in industry are
STURTEVANT
TORQUE WRENCHES
Read by Sight, Sound or Feel.

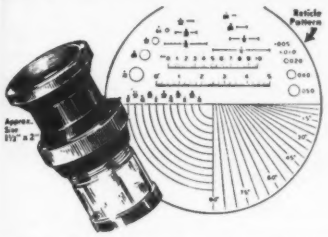
- Permanently Accurate
- Practically Indestructible
- Faster—Easier to use
- Automatic Release
- All Capacities

in inch ounces . . . inch pounds . . . foot pounds (All Sizes from 0-6000 ft. lbs.)

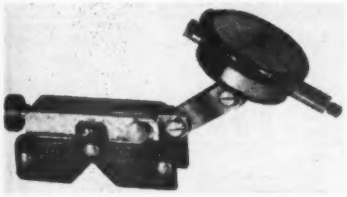
Every manufacturer, design and production man should have this valuable data. Sent upon request.

PA STURTEVANT CO.

Pocket Comparator. This instrument is excellent for fast, accurate measurement and inspection of small parts and small dimensions. It is a quality control tool, that can be used

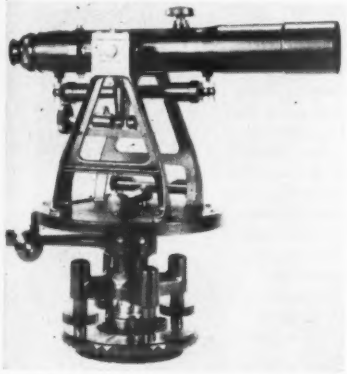


for checking layouts and machining on tools, dies, gages, or to check threads, chamfers and small holes. The instrument is made by the Edmund Scientific Corp., Dept. 236, Barrington, N. J. **Circle No. A18.**



MAGNA-HOLDER FOR INDICATORS. Some of the practical uses of the Erick Magna-Holder are as a surface gage on metal surface plates, for accurately resetting cutting tools, after grinding, for double duty as lathe stops for turning O.D. and holding depth and for double duty in setting up milling operations. Made by the Cullen Mfg. Co., Racine, Wis., the instrument's base dimensions are 3 1/2" long x 1" high x 1" wide.
Circle Inform-A-Gram No. A19.

Location & Alignment of Jig and Fixture. The Optoplane, a new industrial model of the Gurley Precise Transit for facilitating jig and fixture location and alignment, has been



added to the line of transits by W. & L. E. Gurley, Troy, N. Y. The Optoplane establishes the horizontal and vertical planes necessary in locating and setting up jigs for sectional assembly.
Circle Inform-A-Gram No. A20.

THE VISE WITH A
THOUSAND GRIPS

A veritable mechanical octopus that grips odd and irregular shaped parts "from ball bearings to multi-bearing shafts" with tentacles of steel.

ASSURES POSITIVE GRIP for any milling, cutting or drilling operation.

SAVES TIME AND MONEY—no more blocking and shimming odd shaped pieces for tool room machining.

UNIVERSAL APPLICATION — Can be used on any and all types of machine tools. Manual and air operated.

PRODUCTION JIG—The jaws form a mold or matrix to take identical pieces for grinding or machining, only has to be set once. Saves many dollars on small production runs.

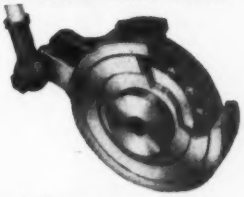
Try it out in your own shop, see what it will do for you, in labor saving, better work in faster time. Built to last a lifetime.

WRITE FOR COMPLETE INFORMATION NOW!

AMERICAN POSITIVE GRIP VISE CORPORATION
1-B Olivine Street • Willimansett, Massachusetts

DURANT INVESTIGATE THE DURANT LINE OF PRESS ROOM EQUIPMENT

INCREASE PRODUCTION! REDUCE COSTS!



THE SELECT-O-MATIC ROLL FEED INDEXER
Replace your present roll feed clutch with this DURANT SELECT-O-MATIC multi pawl indexer that accurately controls close feeding due to its 6720 possible stations.

Write for complete information on our line of economically priced press room equipment

ROLL FEEDS

Choose from seven different models that take stock from 2" to 5" wide — Insures accurate feeding — Reversible — Simple to install.

SCRAP CHOPPERS

Fits all power presses and has simple electrical plug in installation. Low first cost pays for itself —Pennies per day to operate.

STOCK OILERS

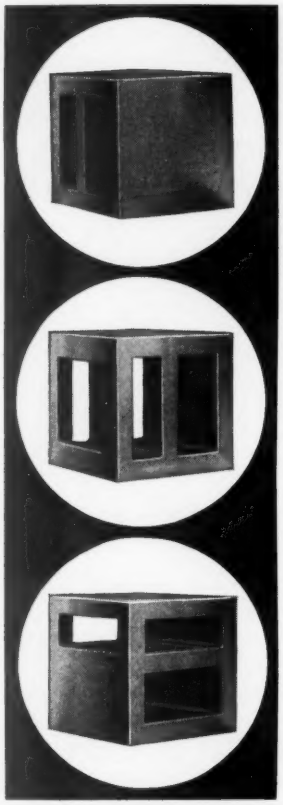
Prolong die life as they clean and lubricate stock in one operation. Variety of models are available. Eliminates hand oiling yet inexpensive.

STOCK STRAIGHTENERS

Motor driven equipment (shown) is perfect for thin materials. Top rolls are adjustable for thickness. Standard straighteners also available.

Inquire about our STOCK REELS, FOOT PRESSES, COIL CRADLES, WIRE STRAIGHTENERS, and PRESS FEEDS. Complete free catalog ready now. Write today.

DURANT TOOL SUPPLY CO. 55 ORANGE STREET, PROVIDENCE 3, R. I.



3 IN 1

COMBINATION TOOL

CHALLENGE UNIVERSAL BOX ANGLE

This new versatile tool has the clamping facilities of an *angle iron* . . . the stability, balance and accuracy of a box *parallel* . . . the perpendicular flat surface of an angle plate. Made of high grade special analysis semi-steel, heat treated and precision ground. Furnished in two sizes — 6x6x6 and 8x8x8 inches. Other sizes can be made to order.

747

Challenge
TRADE-MARK ®

THE CHALLENGE MACHINERY COMPANY

Office, Factories and Show Room:
Grand Haven, Mich.

Severance CUTTING TOOLS

HIGH SPEED CARBIDE

MIDGET MILLS - ¼" Shanks

GROUND-from-the-Solid

ACTUAL SIZE

TEN LEADERS

MORE THAN 20 SHAPES—EACH IN SEVERAL SIZES

Obtain the best from the originator of GROUND from the Solid

Severance JUNIOR MILLS-⅛"Shanks

GROUND-from-the-Solid

SET OF TEN

Practical for use on small grinders, for finishing Patterns, Dies, Parts, etc., in places difficult to reach with the larger Mills.

HIGH SPEED and CARBIDE

ACTUAL SIZE

Truly REVOLUTIONARY Cutting Tools

Severance LAB MILLS—3/32" Shanks

These speedy Mills for Dental Laboratories find many uses in Jewelry and in Die and Mold making. Available in 10 popular shapes in 4 or more sizes each, for the finest cutting and finishing. May be reground up to 8 times per 1/32" reduction in diameter

ACTUAL SIZE

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HIGH SPEED
Out-Perform Dental Burs and Grinding Points

Complete REGRINDING Service — by New Tool Craftsmen
— Savings are thus multiplied —

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Severance Tool Industries
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730 IOWA AVENUE — SAGINAW, MICHIGAN

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SAVE TIME AND MATERIALS

Oil-hardened tool steel tapered pin gages accurate to + 0.0001" — 0.0000" insure dependable sizing and location of holes and slots for machinists, set-up men, tool and die men, inspectors, all who need precise hole measurement.

CONCENTRIC TAPER on lower half of each gage fits holes 0.0012" smaller than standard letter, fraction, and number size drill holes. Makes insertion easier. Permits gaging of odd-size holes and slots.

ALL GAGES are 1½ inches long. Sets contain a pair of each size in a plastic case with 4-place decimal equivalents of each size plainly marked.

ALL ITEMS STOCKED FOR IMMEDIATE DELIVERY

THE Horberg GAGE COMPANY

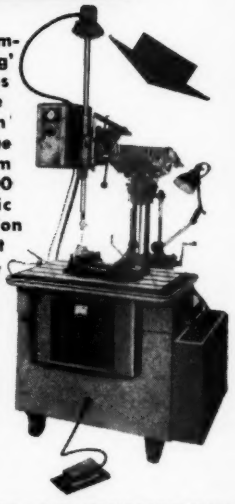
Quantity **29 STAPLES ST., BRIDGEPORT, CONN.**

..... Letter sets @ $45. 52 gages (A-Z)
..... Fraction Sets @ $50. 60 gages (1/64" to 1/2" in 1/64" steps)
..... Number Sets @ $90. 120 gages (1 to 60)
..... Single gages @ $ 1.
..... Stand alone @ $10.

Please Rush checked items and literature to

company.....
address.....
name.....
title.....

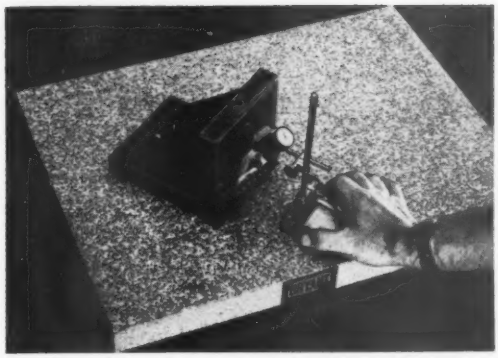
DRILL HOLES AS SMALL AS .030" IN ANY METAL OF ANY HARDNESS OR THICKNESS!



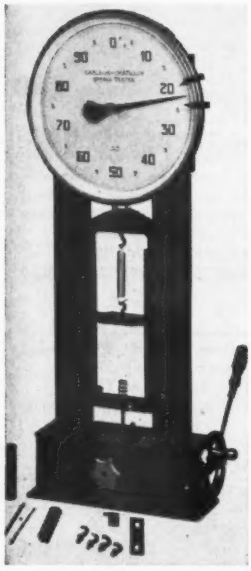
The M-300 Elox Electron Drill* combines the best in the 'arc machining' process. In addition to drilling holes as small as .030" it is adjustable for machine finishes ranging from *coarse, fine, extra fine and super fine* ...on any metals from magnesium to cemented carbide. The M-300 with exclusive Elox Automatic Feed allows for continuous operation with much of the human element removed. Using electrodes costing less than 3¢ per inch, with 'super fine' cutting, 1" of electrode will cut as much as 33" of hardened steel! Here indeed, is a dual-purpose machine that is being used for production machining of hardened steels and for removing broken drills in salvage. Write today for details and list of users.

ELOX CORPORATION OF MICHIGAN

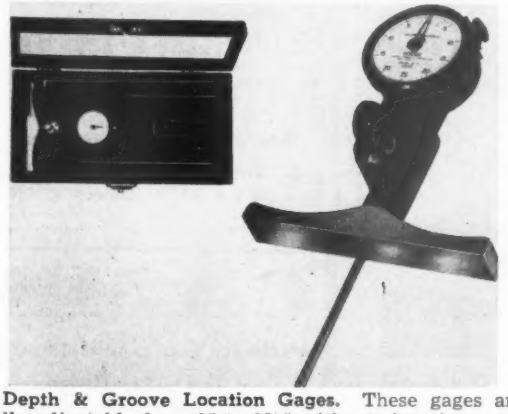
740 N. ROCHESTER RD. • CLAWSON, MICHIGAN



Granite Surface Plates. Designed for use as reference plates in layouts, inspection and assembly work, these Bryant Surface plates are made of granite from the Rock of Ages quarry in Barre, Vermont. A free folder giving full details of the plates is available from the Bryant Chucking Grinder Co., Springfield, Vermont.
Circle Inform-A-Gram No. A21.



New Spring Tester. This testing instrument test loads and deflections of medium size compression and extension springs and has a capacity to 100 pounds. The large 15" diameter dial is easily read and meets the National Bureau of Standards requirements for accuracy of 1/4 of 1 per cent. The instrument is adaptable for general and high quantity production testing. A descriptive bulletin is available from the Carlson Co., 277 Broadway, New York 7, N. Y. Springs with diameters up to 4" and lengths to 12" can be tested. Steel rules measuring lengths in 32nds and 64ths on one side also measure lengths in decimals on the reverse side. The testers are built of welded steel.
Circle No. A22.



Depth & Groove Location Gages. These gages are fully adjustable from 0" to 6¾" without changing measuring rods. The gages provide an accurate and convenient inspection of depths of holes, slots, shoulders and recesses. Write for the bulletin on gages to Reliant Industries, 4947 Firestone Blvd., South Gate, Calif.
Circle Inform-A-Gram No. A23.

NOW! SAVE ON SET-UP TIME!

With Faster Cutting

D-M-E TAPERED MILLING CUTTERS

MACHINE ANGLES, DRAFTS or RELIEFS WITHOUT TILTING THE MACHINE HEAD OR THE WORK PIECE!

TOPS IN SMOOTH CUTTING PERFORMANCE

You can take Faster, Smoother cuts, WITHOUT CHATTER. Made from the finest High Speed Steel to prevent breakage and costly "down time". You'll save Time and Money with D-M-E Tapered Milling Cutters!

FREE! Write for your convenient TABLE OF DRAFT ANGLES. Gives the actual decimal amount of draft or relief for any given depth of all angles from ½ to 30 degrees.

IN STOCK!
From ½° to 7° per side
Write TODAY for Data Sheet 522

DETROIT MOLD ENGINEERING CO.
6686 E. McNichols Rd. – Detroit 12, Mich. – TW. 1-1300

HILLSIDE, N. J. 1217 Central Ave.
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Uneeda LIGHT

directs a beam of white light on your close precision work.

Tool and Die Makers acclaim it for its utility, getting into nooks or crevices hard to get at with ordinary light—for lining up punches in dies, or working with the scriber in close places. Completely adjustable and portable. Light does not reflect back to your face. Ideal for Inspectors seeking burrs, flaws, etc. Price—complete with 2 size bulbs, $13.75.

Write for Literature

TWENTIETH CENTURY MANUFACTURING CO
Box 429-TP Libertyville, Illinois

T-Slot and Dovetail Cutters *by* Reltool!

● Reltool T-Slot Cutters, both straight and taper shank, have staggered teeth and undercut with side chip clearance. Greater chip room results in freer cutting action, reduces breakage.

● Reltool Shank Type Dovetail Cutters for use in Reltool End Mill Holders take the place of arbor type and threaded hole angle cutters. Reduced set-up time and easier handling mean greater efficiency in milling dovetails.

The RELTOOL Line Includes: Combined Drill and Countersinks • Cut-off Blades • Die Sinking Cutters • Dovetail Cutters • End Mills • End Mill Holders • Hollow Mills • Key Seat Cutters • Lathe Centers • Lathe Mandrels • Machine Countersinks • Metal Slitting Saws • Milling Cutters — all types • Screw Slotters • Tool Bits • Specials.

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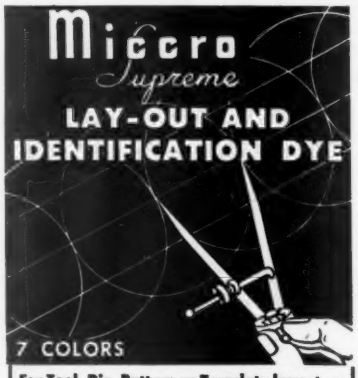
Reltool CORPORATION
RELIABLE METAL CUTTING TOOLS
4540 W. BURNHAM ST. • MILWAUKEE 46, WIS.

A 7448–½

Miccro Supreme
LAY-OUT AND IDENTIFICATION DYE

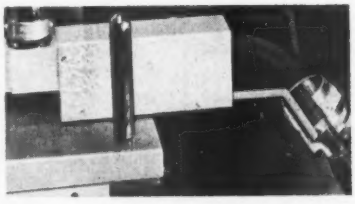


For Tool, Die, Pattern or Template layout on metal . . . Quick identification of bar stock, sheets, strips or parts . . . Shows up in sharp relief—dries instantly . . . Write for sample and circular on company letterhead.

MICHIGAN CHROME & CHEMICAL COMPANY
8615 Grinnell Ave. • Detroit 13, Mich.

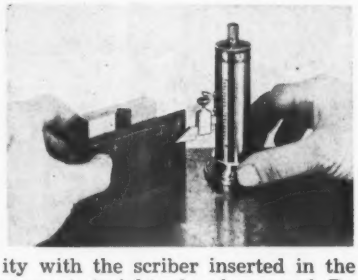
This Optical Instrument is specially designed for measuring entrance angles of wire drawing dies, is announced by American Optical

Co., Instrument Div., Buffalo 15, N.Y. Unskilled operators, with only a few minutes instruction can check to an accuracy of plus or minus 10 minutes of arc. **Circle No. A24.**



FOR MEASURING SURFACE ROUGHNESS on internal tapers such as the one illustrated, the Micrometrical Mfg. Co., 345 S. Main St., Ann Arbor, Mich., has developed the Profilometer Type KC Tracer. This tracer can be used on other surfaces that can be only reached by a tracer with a dogleg beam. Further details and specifications are given in Bulletin LT81, which is available on request. Circle Inform-A-Gram No. A25.

Micro-Height Gage. This gauge combines the easy reading of a micrometer caliper with the scribing features of a Vernier height gauge. It comes equiped with a high speed steel scriber which gives it 2" capac-



ity with the scriber inserted in the support straight edge downward. By reversing the scriber, exactly 1" is gained, increasing the direct capacity of the gauge to 3". This instrument is made by Fairfield Gauge Co., 170 Herbert St., Bridgeport 6, Conn. **Circle Inform-A-Gram No. A26.**

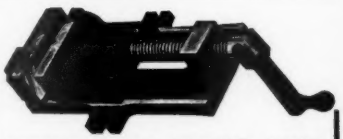
3 WAY
RECIPROCATING—
ROTARY—OSCILLATING
Di-Profiler
TRADEMARK

Used with any standard flexible shaft machine—speeds up to 12M RPM.

The Di-Profiler is a new multiple action tool that (1) Reciprocates (2) Oscillates and (3) Rotates when used with the spindle attachment. Stroke is adjustable from 0" to ¼". Electrically operated.

It files, hones, polishes, laps, chafes and saws materials ranging from carbide tools to soft materials. The only machine of its kind. Write for full details and price list today.

Nord INTERNATIONAL CORPORATION
P. O. Box 44T Denville, N. J.



YOST DRILL PRESS VISE

● This new Yost vise has been designed expressly for use on drill press operations. Does away with special and costly jig fixtures.

OFFERED IN TWO SIZES

Vise No.	Width of Jaw, Inches	Opens Inches	Weight Pounds
1D	3½	4	12½
2D	5	5½	23

Do you need a vise of ANY type?
Write today for bulletin on the extensive Yost line

YOST MFG. COMPANY
1000 MAIN STREET
Meadville • Pennsylvania

Abrasive Cent-R-Lap Tool

Saves time, eliminates diamond dressing. Cones changed in seconds. Available in 2 sizes, 3/8" and 3/4" Cent-R-Laps and abrasive cones in leading grits.

Write for descriptive literature and prices.

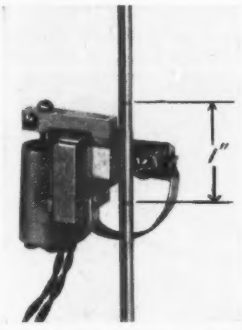
J. R. Reich Manufacturing Co.
45 E. Stroop Rd. Dayton 9, Ohio

CAMS

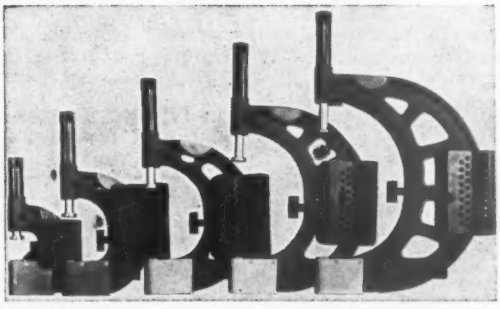
Made to Your Specifications

Let Us Handle Your Cam Problems

BLOOMFIELD TOOL CORPORATION
30 Farrand St. Bloomfield, N. J.

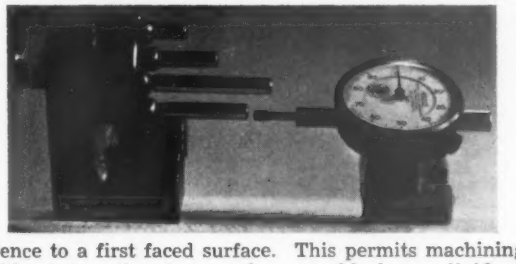


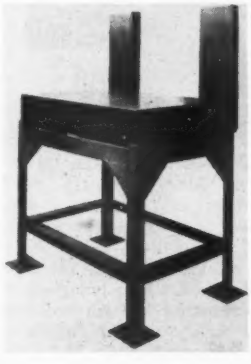
High Magnification Extensometer. Tinius Olsen Testing Machine Co., Willow Grove, Pa., has a new high magnification Extensometer for gage lengths of 4/10" or ½" for 1/16" to ⅜" diameter specimens. Extremely light in weight, the Extensometer is used with Olsen Model 51 Electronic Recorder for detecting strain under both elastic and plastic tension test.
Circle No. A27.



New Air Snap Gage. The wide adjustment of this **QUALITY CONTROL** tool makes it possible to cover a capacity from zero to 6" with only five sizes. The gages are protected from jamming and errors caused by heat transferring from the operator's hand. The tool gives a direct reading to the nearest 0.00005". It is made by the Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Circle Inform-A-Gram No. A28.

Dial Indicator. This multi-stop long range indicator has been designed to obtain repeatable accuracy of 0.0005 on engine lathes. Depths of shoulders, undercuts, chamfers, recesses, etc., are read on the dial with reference to a first faced surface. This permits machining without resorting to a scale, gage blocks or dividers. The indicator is made by the Claremont Instrument Co., 7809 S. Claremont Ave., Chicago 20, Ill.
Circle Inform-A-Gram No. A29.





Black Granite Surface-Angle Plate. This combination of angle and surface plate is made to extreme precision. Nature's own "heat treating and normalizing" removes all internal stresses within the granite. This insures an inherent stability which will retain the accuracy of flatness and angle to which these tools are made. The plate is a product of the Rahn Granite Surface Plate Co., 641 N. Western Ave., Dayton, Ohio.
Circle No. A30.

IMMEDIATE DELIVERY
on SOCKET HEAD CAP SCREWS

. . . Up to 12" Long!
on ½", ⅝" and ¾" Dia. Screws
and No Special "Set-Up Charges"

WHY HOLD UP YOUR WORK . . . for long deliveries on those so-called "special length" screws? You can get really fast service on high-quality Socket Head Cap Screws, Stripper Bolts and Dowel Pins . . . AND you don't have to pay special set-up charges either! D-M-E's large volume turn-over enables you to get in on the savings!
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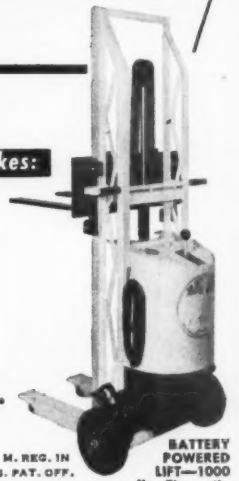

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BATTERY POWERED LIFT—1000 lbs. Finger tip control

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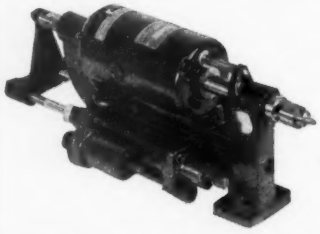
. . . and at low cost with Electro-Mechano compact drill units. Typical set-up above is used by a Racine screw machine company; four units drill #50 holes in stainless steel fuel nozzle caps. Production was increased from 40 to 190 pieces per hour.

These fast acting complete drill units speed up many simple drilling jobs and simplify complicated multi-spindle jobs. Direct electric motor drive variable speed spindle provides 1000 to 10,000 or 2500 to 15,000 RPM; employs economical air feed with adjustable hydraulic control. Supplied in pad and column mount, with manual, electric or automatic trip; drill cap. .004" to .156". Precision sensitive bench and floor models available up to ½" cap.



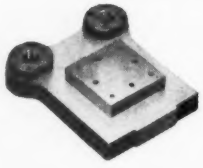
FOR SIMPLE OR COMPLICATED SET-UPS

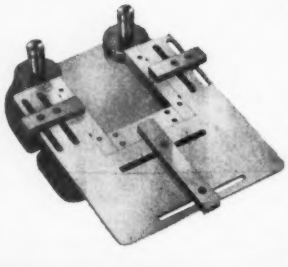
get more information, write for bulletin 1-109

THE ELECTRO-MECHANO CO.
260 E. ERIE ST. MILWAUKEE 2, WIS.

Punches and Dies

Notching Die with Gauge Table





Standard stock sizes 4", 5" and 6". Lick those Notching Problems QUICKLY. Gauge table and gauging bars provide accuracy and speed with easy adjustment.

This is another of the many different kinds of punches and dies in stock or made to order for foot, hand or power operation. Precision made from high grade tool steel. Also adaptors and die shoes to convert your press.

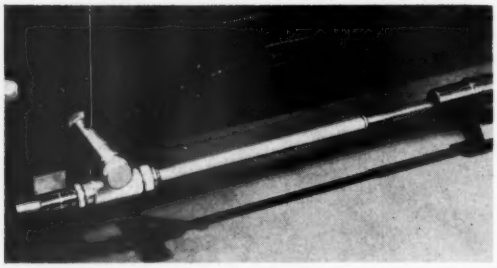
—or what have you?

What are your punch and die needs? Consult us about these problems. Satisfaction is your reward when you Re-WARD your orders.

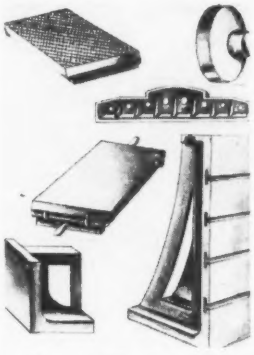
Send for free illustrated catalog No. 152 AA. Net prices shown.

WARD Machinery Co. 564 West Washington **Chicago 6**

Measuring Roughness. Micrometrical Mfg. Co., 345 S. Main St., Ann Arbor, Mich., has a new line of six Profilometer LE-type Tracers for taking roughness measure-

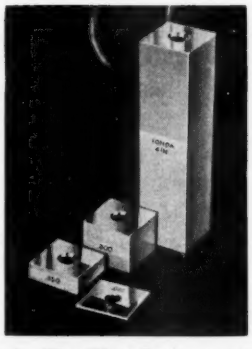


ments in holes as small as ½" ID, as deep as 24" and from 1 to 75 microinches roughness. Full details and specifications given in Bulletin LT84, available upon request. **Circle Inform-A-Gram No. A31.**

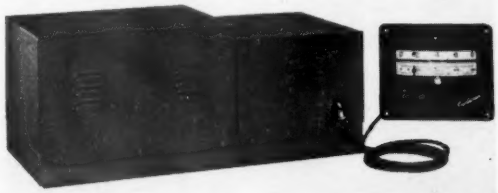


Inspection Tool Castings. The cost of inspection tools and fixtures can be drastically reduced by using standard cast shapes and machining them in your own shop. The Myerstown Foundry and Machine Works, Box 296, Myerstown, Pa., has a catalog available listing their many shapes and sizes of inspection tool castings, some of which are pictured at left. **Circle No. A32.**

Square Blocks. With the inclusion of square blocks, Fonda Gage Sales Corp., 38 Broad St., Port Chester, N. Y., now has on hand square and rectangular blocks in steel, carbide and chrome carbide. Quick identification is provided for by numbering on the ground band of the larger blocks and etchings on the gaging surfaces of the smaller ones. **Circle No. A33.**



Strapless Temperature Control. The West Instrument Corp., 525 N. Noble St., Chicago 32, Ill., offers a radically different temperature controller which gives unusually close control. Because this instrument holds temperatures with no under or over shooting, less rejects and



lower production costs can be expected. This instrument is extremely compact. Two sections make up the complete controller, except in higher capacity units where intermediate amplification is necessary. One section contains the temperature indicator, parts of the instrument control circuit and the control pilot lights. The other section contains the heavier parts of the controller circuit. A six conductor cable, which is supplied, connects the two sections. Separating the control and indicator units makes it easier to mount the indicator section. **Circle Inform-A-Gram No. A34.**

Use KIPP AIR GRINDERS if you want to GRIND —not just rub!

MODEL JA
50,000 R.P.M.
$42.00
IN U.S.A.

Weight 12 ounces; length 6¾ inches; chuck size ⅛ inch. Wheel guard removed for better illustration.

The RPM's stay up while grinding . . . not only when the grinder runs idle.

It is an established fact that surface speeds must stay up to approximately a mile a minute if you want to grind — not just rub. Every mechanic knows this, but inexperienced buyer may order tools that maintain proper grinding speeds only when running idle. The speed of Kipp air grinders drops but slightly when put to work. That means better work—longer wheel life.

Buy Kipp air tools for best results, lower prices.

MADISON-KIPP CORP.
212 Waubesa St., Madison, Wis., U.S.A.

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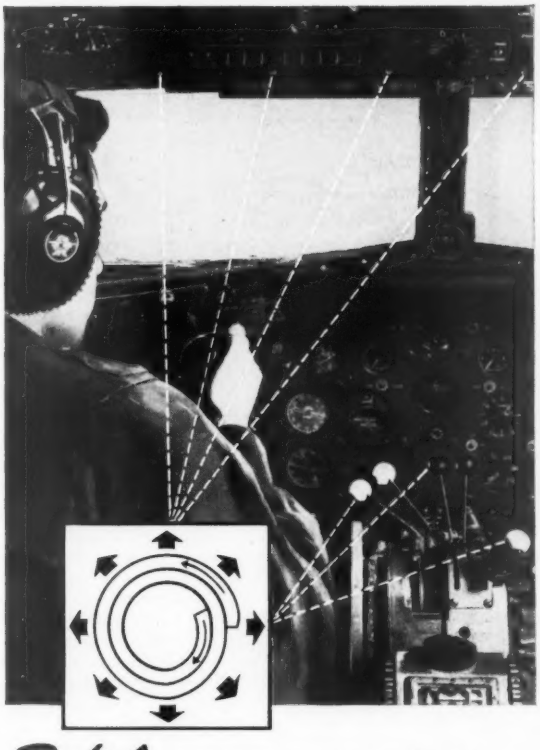
SPIROL SOLVES THE TOUGH ONES:

SPIROL PIN
fastens fragile plastic!



Radial spring action fastens knobs and panel without breakage

In fastening the plastic instrument panel above, Spirol Pins were used as bushings to absorb stress and eliminate the problem of breakage. In the same plane, Spirol's unique radial spring tension locks control knobs firmly to levers — eliminates screws entirely.

When compressed by insertion, SPIROL PINS exert even, all-round pressure, develop no weak "hinge" lines. Coils in light-duty pins are highly flexible, insert easily and without damage into brittle parts. "Live" action keeps pins locked tightly in hole — prevents material wearing loose around fastening.

For heavy duty applications, radial coils give SPIROL PINS enormous strength — unsurpassed resistance to vibration and shock. Available in standard diameters 1/32" to 1/2" — lengths, 1/8" to 4". Non-standard materials and sizes to order.

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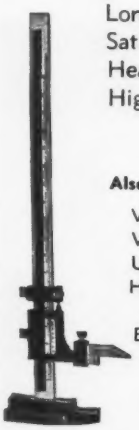
NEW SATIN CHROME
precision
HEIGHT GAGES
12" to 36"



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Satin Chrome Finish
Heavy Construction
Highest Precision

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Hand Scraped Surface Plates
Bench Centers

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HAND WHEELS
HAND KNOBS
MACHINE HANDLES
HANDLES
BALL HANDLES
SPECIALTIES

Specify Tomco for long lasting dependability

A complete line of high grade hand knobs, handles, and hand wheels is available from Tomco. Immediate shipments are made from stock of standard items. Specialty items are made to your specifications.

For original equipment or replacement parts look to Tomco for quality and service.

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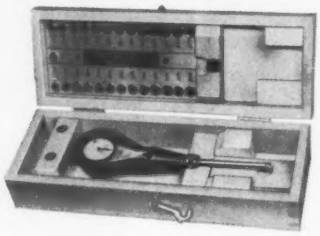
RACINE, WISCONSIN

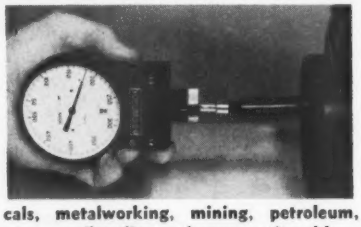
Blank or Machined - from stock

As a Development of its Small Bore Gage. Standard Gage Co. Inc., Poughkeepsie, New York, announces complete sets of centering size discs



whereby this gage can measure any bore within its overall range of ½" to ⅝". Previously it had been furnished as a "singlehole" gage for one specified dimension.
Circle Inform-A-Gram No. A35.

FOR CHECKING RPM. Here is an instrument for instantaneously checking the rpm of motors, machinery, revolving shafts, etc. It is used in such diversified fields as textiles, transportation, chemicals, metalworking, mining, petroleum, power, railroading and construction. Manufactured by Montgomery and Co., Inc., 53 Park Place, New York 7, N. Y., the instrument gives a minimum reading of 40 rpm and a maximum of 50,000 rpm. Circle Inform-A-Gram No. A36.



A New Line of Straight Edges in lengths up to 48" is now being produced by the Collins Microflat Co., 2326 E. 8th St., Los Angeles 21, Calif. The straight edges are for

precision measurement and checking of surfaces of machine tool beds and areas where absolutely flat surfaces must be checked with accuracies up to 0.00005". They are velvet smooth, never require oiling and are rust-resistant.
Circle Inform-A-Gram No. A37.

DO YOU WANT TO KNOW?

The exact size of your Screw Threads, the actual discrepancy of Rejects, how much to allow for Plating, how to avoid Rejects?
Limit or Ring Gauges cannot supply the answer, but the O-Vee Comparator with its patented screw thread measuring principle, will indicate the actual size of a screw without the need for costly set plugs. Used and approved by leading Government Depts., Aircraft & Automotive plants.

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Here's a truly "one man" press. It operates with one hand. Handy for tool and press rooms, it permits the diemaker to complete a die-set at his bench . . . saves toolroom and handling costs. Ask today for full details.

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KEYWAY CUTTING
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GLENNY Adjustable push BROACHES

STRAIGHT ACCURATE KEYWAYS

NO SHIMS NO BUSHINGS

★ Reduce Costs.
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(Also One Pass Broaches for Single or Multiple Keyways)

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tough . . .
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Precision-made of both Carbon Vanadium and high carbon, high chrome steels. Available in a wide range of stock sizes from 1/32" to 1" point diameters in increments of 1/64" for immediate delivery. Decimal sizes to order for delivery within 48 hrs.

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Hole tapered to eliminate slug jamming. Sizes in stock to match punch sizes.

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Distance between centers 20"
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Thousands in use all over the world. Many in this country where they may be seen in operation.

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Punches Shaped from the SOLID with OTTMANN Punch Shaper

FEATURES:

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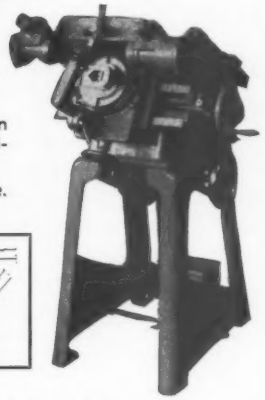

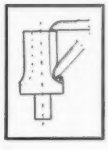

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Thermo Electric Mfg. Co., 474 Huff St., Dubuque, Iowa

protect your machinery with

maintenance-free **LOVEJOY**

FLEXIBLE COUPLINGS

When you install Lovejoy Flexible Couplings you get more than just long-lasting smooth power transmission. You get maximum protection against surge, blacklash and starting torque. You get reduced down-time and less maintenance, since cushions can be changed without shutdown and Lovejoy Flexible Couplings never require lubrication.

Accurately machined bodies and jaws and cushioning materials engineered to the load conditions are combined in a compactly designed coupling to keep your machinery running better . . . longer. *Types and sizes for all applications.*

Send for complete catalog . . . contains full technical data and handy selector charts for your convenience. Yours without obligation.

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LOVEJOY FLEXIBLE COUPLING CO.

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RAYMAC solid carbide reamers are custom designed for individual jobs. Our engineering department is at your service to solve your reaming problems.

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Shows you new, quick, easy ways to save time, labor, actual dollars and cents in your Tool and Die salvage welding operations.

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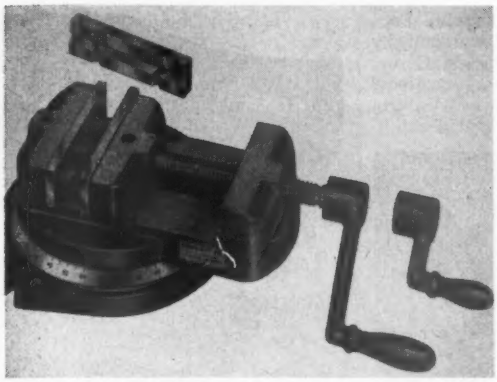
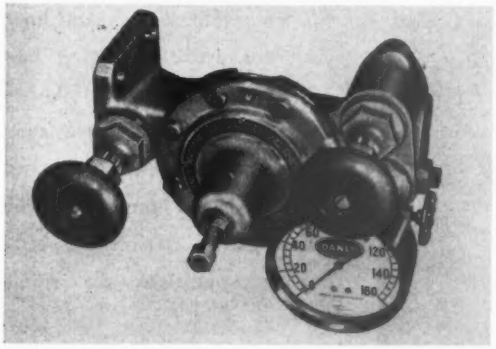


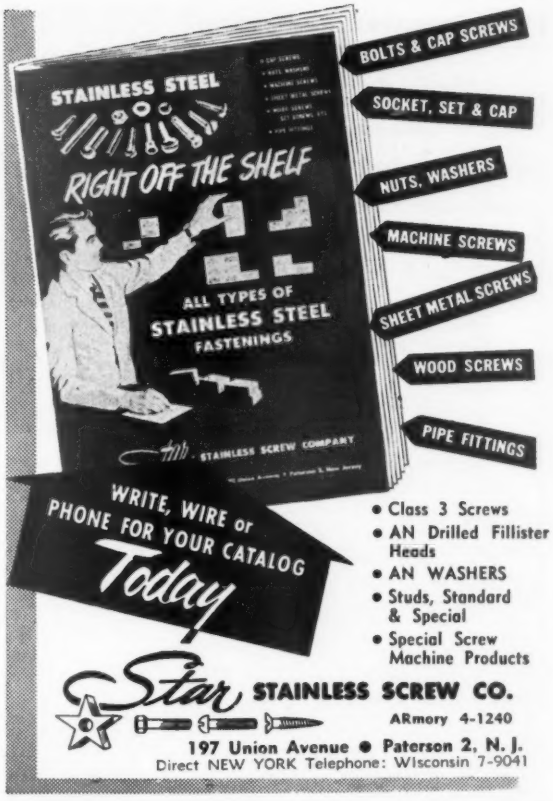
Milling Vises. Maximum rigidity and vibration-free construction are the qualities offered in the new line of milling vises produced by the Kenco Mfg. Co., 5211 Telegraph Rd., Los Angeles 22, Calif. The vise body is secured to the base by means of 3 bolts directly beneath where the work is clamped—thus eliminating vibration.
Circle Inform-A-Gram No. A38.

This Is A Lamson Overload Protector. It is a new device to protect chain drives of all types from over load. This is accomplished by tripping a limit switch in the event there is excessive tension on the drive leg. It consists of an eccentrically located idle sprocket counterbalanced by a weight-loaded arm. The counterbalance is adjustable in such a manner that the device will operate at any chain tension up to 1,000 pounds. Further information available from Lamson Corp., Dept. A14, Syracuse 1, N. Y.
Circle No. A39.

Air Control Manifold Valve. Introduce for use on mechanical presses to control air pressures on such devices as die cushions, counterbalance cylinders, clutches and brakes and automation auxiliaries, the Danly Air Control Manifold also offers advantages for many types



of pneumatic circuits that require pressure regulations. The manifold brings into one compact unit a regulator plus the accessory valves, pressure gage and fittings normally required to control pressure in an air line. For further information write to Danly Machine Specialties, Inc., 2100 S. Laramie Ave., Chicago 50, Ill.
Circle Inform-A-Gram No. A40.



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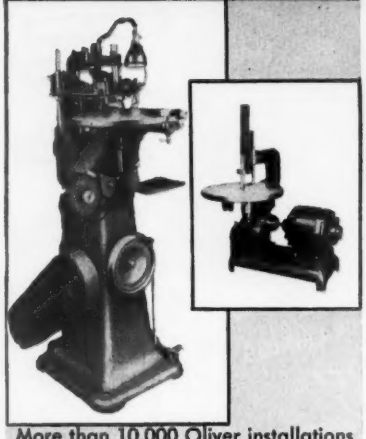

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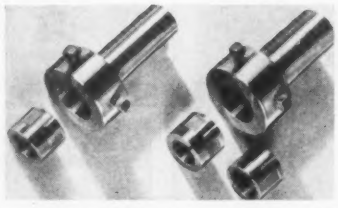
The New Model 11 Machine Tool Locating Microscope, developed by Perkin-Elmer Corp., Norwalk, Conn., can be attached to machine tools such as jigborers or vertical milling machines. It aids the machinist in

checking contours, slots and surface conditions that cannot be approached by mechanical devices or indicators. Model 11 magnifies 30x — great enough to observe work with .0001 tolerance. Its field of view includes a full ¼ inch of the workpiece. All table movements appear in their true direction when viewed through the eyepiece.

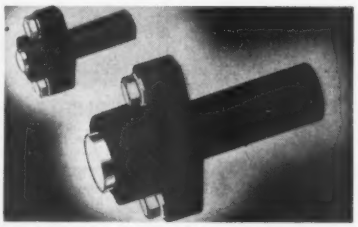
Circle Inform-A-Gram No. A41.



A NEW PRECISION GROUND TOOL ADAPTER for Brown & Sharpe automatic screw machine has been introduced by the American Cam Co., Inc., Hartford, Conn. With only two adapters in place of the conventional 6, it is now possible to use No. 00 stools on machines and either No. 00 or No. 0 tools on No. 2 machines.

Circle Inform-A-Gram No. A42.

Aligning Drills, Reamers and Similar Tools with the work is made easy with Barnaby floating holders. The cutting tool is held in the head of the holder either directly or by means of a bushing and is securely



clamped by a set screw. The Barnaby Mfg. Co., 70 Knowlton St., Bridgeport, Conn., adds to the value of the holders with a newly developed Du-Lite black finish.

Circle Inform-A-Gram No. A43.

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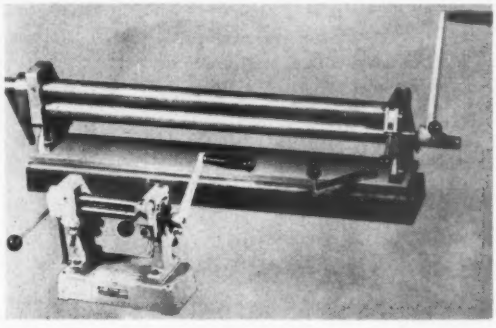
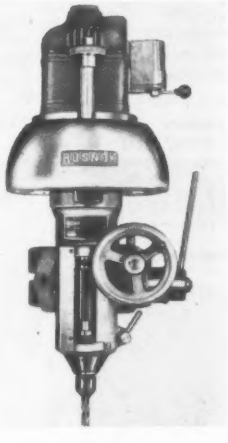
Increasing Bending Versatility. Six new models of a hand operated roller have been added to the line of Di-Acro metalworking equipment made by the O'Neil-Irwin Mfg. Co., 626 Eighth Ave., Lake City, Minn. These

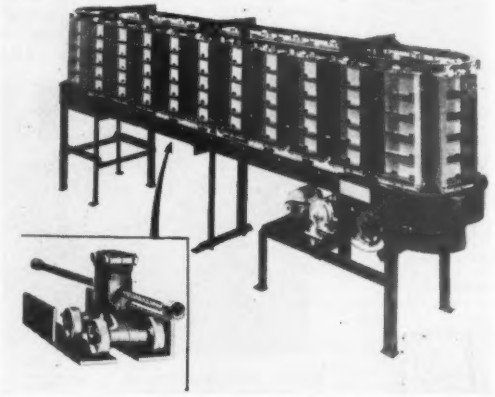


models, designated Di-Acro Rollers, have material capacities ranging from 16 to 24 gauge sheet steel, forming width ranges of 12 to 42 inches and a radius capacity of from 2" to infinity. Complete information furnished upon request. **Circle Inform-A-Gram No. A44.**

The Rusnok ST Mill Head is now being made with a full 1 hp motor with capacity of ¾" end milling in steel. This is in addition to the standard ½ hp motor furnished on the ST heavy duty and the ¼ hp which is standard on the No. 70 Convertical Model. A new booklet with specifications, dimensions and complete information on the Rusnok line of mill heads is available by writing to Rusnok Tool Works, 4840 W. North Ave., Chicago 39, Ill.
Circle No. A45.



"Table-Cable" Conveyor. A new table height, power driven cable conveyor with 4-wheel carriers attached to a ⅜" steel cable has been announced by the E. W. Buschman Co., 4401 Clifton Ave., Cincinnati 32, Ohio.



Pallets, shelved trays, fixtures, rotators and other devices can be attached to the conveyor trolleys. The conveyor can also be attached to load bars or out rigger roller frames for production, assembly or finishing operations. Further details can be had by writing for Bulletin 40.
Circle Inform-A-Gram No. A46.

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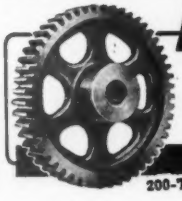

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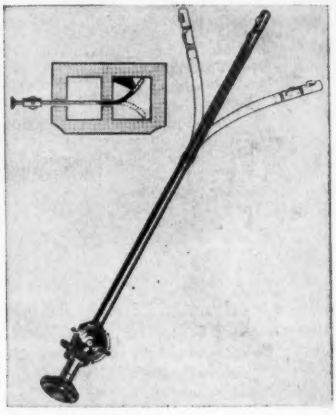
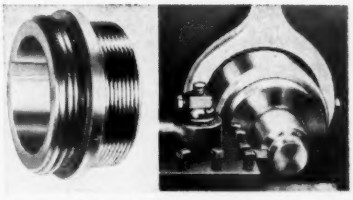
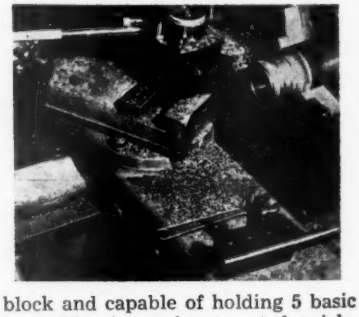


barrels, airplane wings, engine castings and other blind areas can be examined with the Industrial Inspectroscope. For descriptive folder write to Eder Instrument Co., 2293 Clybourne Ave., Chicago, Ill.
Circle Inform-A-Gram No. A47.



This New Adapter Nut is designed to adapt the Hall Model B-2" Collet Chuck to L-00 taper spindle lathes. Made by the Hall Mfg. Co., 622 Tularosa Dr., Los Angeles 26, Calif.
Circle Inform-A-Gram No. A48.

Engine Lathe Operation can be put on a productivity basis comparable with turret lathe operation thanks to this new Marvic toolholder. Consisting of a 4-faced



block and capable of holding 5 basic tools, Marvic can be mounted quickly and easily on any engine lathe. Further information available in Marvic's new fully illustrated catalog. Write to Marvic, Inc., 350 Peninsular Ave., San Mateo, Calif.
Circle Inform-A-Gram No. A49.

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hole location,
easy contour
inspection with
new machine
tool microscope

Any machine shop, large or small, can save time and money on milling and boring work with the new Perkin-Elmer Model 11 Machine Tool Microscope. For hole location, its wide field of view (¼") or 30x magnification makes it possible to gage accurately to a ten thousandth—*at a glance.*

Mount the Model 11 on an offset bracket or directly in the spindle—it will fit nearly any machine tool. When offset it can be used for transferring hole locations from template to workpiece. The image always appears erect and moves in the same direction as the work, making it ideal for checking contours, slots, surface conditions. The Model 11 Microscope is compact, sturdy, rugged—designed for long life, accurate service.

Write today for complete details.

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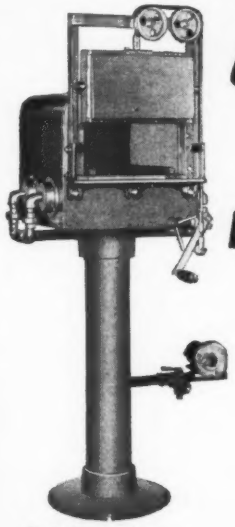

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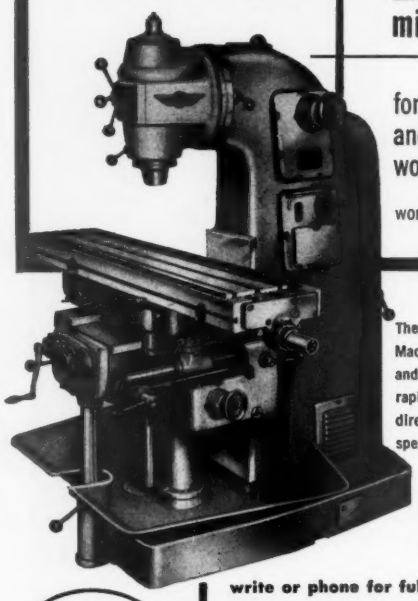

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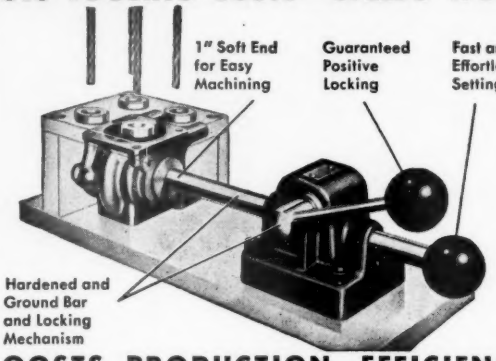
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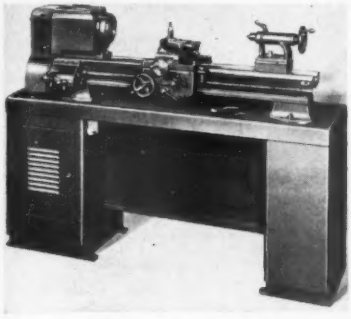
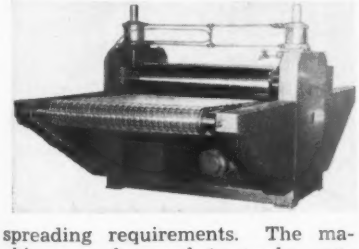
A 12" Lathe with such new features as a heavy headstock, double V-belt outboard drive and a ball bearing mounted spindle is now being



produced by the Logan Engineering Co., Lawrence and Lamon Aves., Chicago 30, Ill. Information on this lathe can be secured from the company. **Inform-A-Gram No. A50.**

Button Head Socket Screws that allow for smoother, more streamlined surfaces are now in full production at the Allen Mfg. Co., Hartford Conn. The rounded tops and flush edges of these screws also prevent exposed sides, thus eliminating the hazard of catching on clothing. Circle Inform-A-Gram No. A51.

Roller coaters which reportedly set a new high in functional efficiency are now in production by the Union Tool Corp. of Warsaw, Ind. They are designed to meet approximately 95% of all types of compound



spreading requirements. The machine can be used to apply compound to one or both sides of the metal. **Inform-A-Gram No. A52.**

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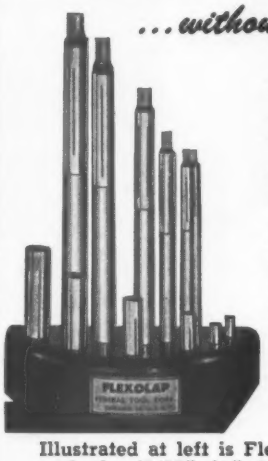
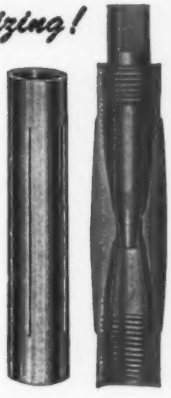
...without danger of galling or seizing!





The Flexolap barrel is made with a series of longitudinal slots milled "off-center" to permit sensitively flexible expansion up to 15%—or more—under pressure of the adjusting pin. This construction enables Flexolap to save valuable time and to lap rounder, straighter holes. For accurate precision take-up, as desired, to maintain size and compensate for wear on barrel . . . simply turn adjustment screw.

Illustrated at left is Flexolap Set No. 1. Includes 6 complete laps, one of each size (3/16", ¼", 5/16", ⅜", 7/16" and ½"), and one additional brass barrel of each size, all held on a sturdy, serviceable stand. Price complete $14.00

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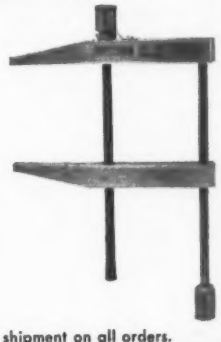

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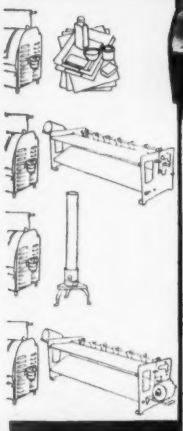

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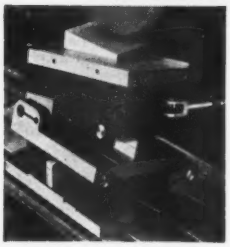

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. . . Automation, from page 139

Fig. 2. Closeup of hopper mechanism (automatic sizing fixture removed) on automation-equipped "Underpass" Gear Finisher. Air Cylinder at right feeds gears into shaving position one at a time. Air-operated expanding mandrel (not shown) clamps parts into position and holds them during shaving operation.

pitch diameter with a 0.734-inch face width. Normal pressure angle is 18° 30′ with a 17° 49′ 6″ left hand helix angle.

The ejected gear rolls down a trough at the back of the machine and lays over gently, flange down, on a wire mesh conveyor, Figure 3, used to transfer the gear to the next operation. A short guide rail extending beyond the end of the exit trough and the weight of the flange combine to position each gear perfectly on the conveyor. The completed gears move down the length of the wire mesh conveyor and empty onto a parts table to complete the operation.

This high production rate is achieved on a standard Model 870 "Underpass" Gear Finisher. Should the automation-equipped machine be needed for shaving other gears, it may be converted to standard operation by removing the automatic loading mechanism and controls.

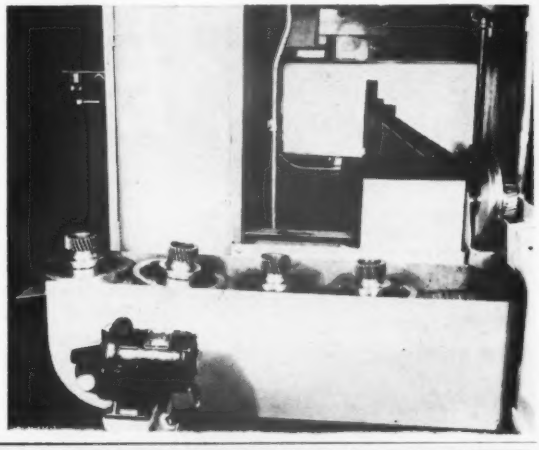

Fig. 3. Finished shaved gears roll down exit trough of the "Underpass" Gear Finisher and are gently layed over, flange side down, on a wire mesh conveyor. Short rail, shown extending beyond edge of trough, and greater weight of the flanged end combine to assure perfect positioning of each part on the conveyor.

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Any decimal diameter to ⅝"—in any length. Mirror finish surface to gage tolerance. Many uses — punches, gages, measuring wires, special tools, etc. Quick delivery.

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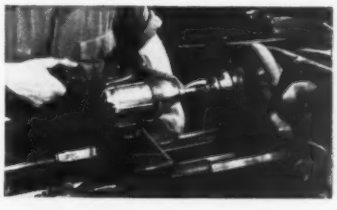

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. . . High Alloys, from page 129

Retorts: Cast in type HH alloy, annealing retorts installed 3½ years ago have given excellent service, and are still in good condition. Since the alloy resists the high sulphur content of the furnace gases, there is little scaling, and the retorts have retained their uniform wall thickness, insuring uniform annealing of the tool steel. No loss of symmetry has been detected. Reinforcing bands have not been necessary, and the furnaces can still be stacked to maximum capacity. Bayonet plug ends, also cast of the same alloy composition, remain gas-tight and easy to handle.

A high alloy wrought material was considered for this application, but a cast material rather than a comparable wrought grade was chosen since the cast alloy is stronger at the application temperature than comparable low-carbon high alloy wrought grades, because of higher carbon content. Furthermore, wrought tubing in the sizes required was not available, and the cost of forming and welding plate would have proven prohibitive.

Muffle Sections

Gas carburizing atmospheres combined with high temperatures pose a special challenge to materials of construction — a challenge being successfully met by the alloys of Group C, particularly by type HT which is useful in carburizing and carbonitriding atmospheres.

This is confirmed by engineers of Michiana Products Corporation, Michigan City, Indiana, who have developed high alloy muffle sections for long term reliable operation at temperatures up to 2000° F in modern mechanized furnaces. In high-volume gas carburizing, the muffles usually function in a temperature range of 1650-1800° F. Analysis of the gas is approximately 33 to 35% H_2, 20% CO, up to 7% CH_4, and the balance is a carrier gas which is about 40% nitrogen.

Prime requisite for the muffle section in the illustration was retention of strength at elevated temperatures, and resistance to both oxidizing and reducing conditions. Since sulphur corrosion was not a problem, one of the high nickel alloys could be used. Type HT, containing 33 to 37% nickel and 13 to 17% chromium (including up to 1.25% silicon for increased resistance to carburization) was selected. This type operates satisfactorily at temperatures up to 2100° F in oxidizing atmospheres, and up to 2000° F in reducing atmospheres, provided that limiting creep stresses for any given temperature are not exceeded. As in all high nickel types, the alloy is fully austenitic and notable for excellent hot strength.

According to metallurgists of the Alloy Casting Institute, the lessons learned from these case histories can be applied to many fields other than heat treating equipment. These conclusions can be briefly summarized; in strong oxidizing or reducing atmospheres with possibly high sulphur content, and where only moderate strength is required, alloys in Class A are generally satisfactory. Where high strength is required, as well as resistance to oxidizing, reducing, or sulphur bearing gases, alloys in Class B normally provide good service. Where even greater hot strength and reliability under cyclic temperature conditions is needed, Class C alloys are frequently chosen and will resist attack by nearly all furnace gases with low sulphur content.

To select the cast alloy within each class best qualified to answer a particular design problem, however, engineers need much specific information, and expert evaluation of the service conditions is advisable. It is wise, therefore, to consult a metallurgist at one of the foundries specializing in high alloys, to be assured that the completed casting will have the desired performance characteristics.

How SUNDSTRAND Hydraulic Division Uses CLEVELAND Electronic Gages To Maintain Accuracy in Production

HYDRAULIC motors, transmissions and pumps are among the products of Sundstrand Machine Tool Co.'s Hydraulic Division, Rockford, Ill. Components are held to tolerances as close as 0.000050"

To make sure of the required precision, Sundstrand uses Cleveland electronic gaging equipment as shown below for checking gage blocks, master gages, production gages and tool setups. J. B. Gehlhausen, Foreman of Tool and Gage Inspection, reports that Cleveland gages are consistently accurate, easy to read, and can be set up or changed over in a minute or two.

Checking gage blocks to 0.000001" for size and parallelism at Sundstrand's Hydraulic Division, using Cleveland MICRO-AC Electronic Microcomparator. Every gage block in the plant is checked annually this way; and all replacement gage blocks are given the same inspection. The standard MICRO-AC reads 0.000010" or 0.000001" per scale division, as selected by a knob on the amplifier panel.

Sundstrand's master and production plug gages are regularly checked with a PAR-AC electronic gage as shown; and all new plug gages are inspected upon receipt. High-speed meter shows deviations from nominal size in increments of 0.0001" or 0.000010" per scale division.

Checking distance between two boring tool bits with INDI-AC Electronic Indicator in Sundstrand's Tool and Gage Inspection Department. This company uses the INDI-AC for all types of surface plate work.

More and more users find, like Sundstrand, that Cleveland electronic gaging equipment offers an unusually useful combination of operating features. Want details? Write for illustrated bulletins.

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INDUSTRIAL NEWS

The Gairing Tool Company has acquired outright the line of Interchangeable Spade Drills and Core Drills formerly made by Conner Tool & Cutter Company of Detroit, Michigan, and Sullivan, Indiana. The transaction includes trade name, manufacturing facilities and inventory.

All operations have moved to the Gairing Company plant in Detroit, where all manufacturing is carried out in accordance to the Conner high quality standards of design and workmanship.

Sales are being handled through the Gairing national sales organization.

◆

Morton Bearing Company. Due to increased business in special anti-friction bearings designed and manufactured to meet specific customer requirements of load and space limitations, the Morton Bearing Company has moved to larger quarters.

They are now located in a new building at 815 Wildt Street, Ann Arbor, Michigan. Additional equipment permits the manufacture of radial ball-bearings, radial roller bearings and needle bearings up to 16" outside diameter. In addition, a complete line of thrust ball bearings, roller thrust bearings, crane hook bearings and self aligning thrust bearings are in production.

◆

Scully-Jones and Company, producer of precision holding and driving tools, has expanded manufacturing facilities to meet the increased demand for "Roll-Lock" Chucking Tools. "Roll-Lock" is a new and fast method of creating a powerful and extremely accurate hold or centering fit for precision work. "Roll-Lock" Mandrels, Arbors and Chucks are precision tools for holding parts or cutting tools during turning, grinding, gaging or inspection operations.

. . . **Carbide Ratchets, from page 138**

its teeth results in improper feed and scrapped saw stock.

Outlasted 60 Hardened-Steel Ratchets—Their previously used oil-hardened steel ratchets were usable for feeding a maximum of 100,000 feet of stock. One carbide ratchet, at time of last report, had fed 6 million feet and was still in excellent operating condition. This amount of production would have required the use of at least 60 steel ratchets.

Comparative cost and performance data listed below shows that the tungsten carbide ratchet has already saved the user over $2,000 in ratchet cost—in addition to savings resulting from minimized down time for ratchet changing.

Kennametal's high hardness and greater resistance to both wear and abrasion makes it suitable for many other industrial applications where increased accuracy and improved performance is required.

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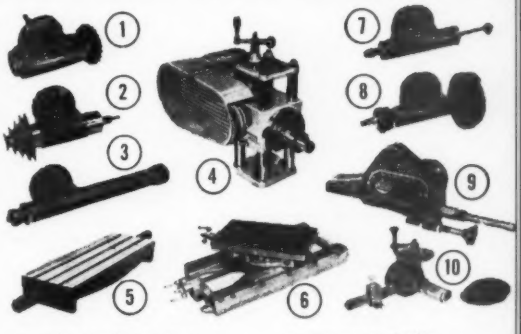

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5. Milling and Grinding Table
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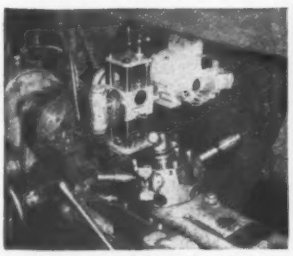
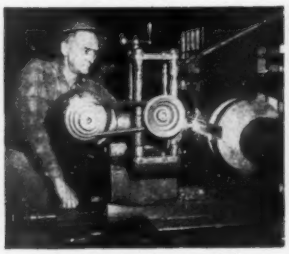
7. Internal Grinder Head
8. External Grinder Head
9. Slotting and Keyseating Head
10. Geared Dividing Head

THREE SIZES
MODEL "C," 1/3 hp—9" to 13" LATHES
MODEL "B," ½ or ¾ hp—13" to 18" LATHES
MODEL "M," 1 or 3 hp—18" to 72" LATHES

The Master attachment can be used profitably on many production operations. Mount it on your present equipment, lathes, turrets, mills, or use independently to perform additional operations in the same set-up. The basic milling unit with the above types of precision heads gives you facilities for milling, grinding, boring, drilling, indexing, slotting, and keyseating, internal and external. Its full complement of equipment is an outstanding value for maintenance, repair, tool room, and experimental shops, as well as production, thus performs a full range of shop operations at a minimum investment. These improved models are outstanding in rigidity, capacity, and simplicity of set-up and operation and incorporate the latest features developed in our 17 years of manufacturing this tool. Investigate this valuable shop tool. For the cost of one single-purpose machine, you can have several Master units producing. Prompt deliveries.

MAKES LOW-COST INDEPENDENT PRODUCTION SET-UPS — PORTABLE — SELF-POWERED


Milling on turret lathe completing part in one set-up


End Milling 2½" keyway in 9⅞" diameter shaft 22 ft. long

Master Slotting Head on lathe cutting internal taper keyway

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. . . Providing Incentives, from page 59

ers, radiators, getters and shields are added finally, and the assembly operation is complete.

It is readily apparent that this involved sequence of operations gives rise to a multiplicity of quality variations. Open welds, poor welds, shorts, damaged parts, misaligned elements, and incorrect assembly are just a few of the factors which drastically affect the initial performance and life of the electron tube.

Installing Control Charts for Fraction Defective

Before the new system was put into effect, inspection was done by monitors or group leaders who 100% inspected trays of finished mounts for obvious defects. A monitor was in charge of several assembly groups, each of which turned out 100-200 finished mounts per hour. Thorough inspection of each mount was

MOUNT DEPARTMENT WEEKLY QUALITY CONTROL REPORT 12/1 -- 12/6

	6098	5687WA	6AX4GT	6096	5A6	6B27
Number inspected	200	270	300	250	265	200
Number defective	14	17	28	20	31	23
Percent defective	7.0	6.3	9.3	8.0	11.7	11.5
Previous week % defective	10.0	2.0	13.3	7.7	15.3	12.0
Process average -- %	7	7	15	7	16	
Crooked mounts	1				7	12
Defective micas	4	3	2	1	2	2
Defective welds	2	4	5	1	3	7
Splashed welds					1	
Defective stems			6		1	
Shorts	1	4				1
Defective peak coating			5			
Defective filaments					13	
Damaged parts			10	1	1	
Defective assemblies		2		17	3	1
Miscellaneous	6					

FIGURE 3

impossible; only the very obvious defects could be found and corrected. Little attention was paid to minor quality variations which often grew, in time, into major sources of trouble.

It was decided that the new system of inspection would be developed and carried on by the Central Quality Control group. If successful, it would be taken over by the mount department.

The first step consisted of selecting one tube type whose quality history indicated a need for improvement. A meeting was held of the tube engineer, the assembly department foreman, and the quality control engineer. A detailed list of all possible defects, including minor variations in quality, was prepared and later used as the itemization for the daily inspection check sheet shown in Figure 1.

The daily sample for detailed inspection consisted of 50 mounts, which were drawn, a few at a time, during several intervals throughout the production period. Reference to Figure 1 shows that on November 3, the first day, eight defects were noted. These defects were not necessarily serious, but they represented deviations from an ideal condition. Some thought was given to the use of weighted defects, assigning a weight of one for a minor item and a weight of two for a serious defect —one which would certainly result in an inoperative tube. Since one of the prime objectives of the program was to provide incentives for better quality among the workers, it was felt that a philosophy of good tube making would be more effectively encouraged through the single weight plan. A major defect is, after all, a minor defect which has gone out of bounds. The program was directed toward an overall quality improvement through increased quality-mindedness, not merely toward a reduction in the obvious defects.

The next step was to post the daily inspection result on the Control Chart for Percent Defective (see Figure 2). The eight defects found on November 3 constituted a 16% quality index for the day ($8/50 \times 100 = 16\%$). Each day the data or work sheet was signed by the group monitor and the figures entered on the control chart, which was hung at the head of the production line where all the workers could see it. The effect was an immediate improvement in quality!

On November 19 a process average (p) was assumed, excluding the two highest days. November 4 and 7. Using this average, an upper control limit was calculated from the relationship U. C. L. $= 2\sqrt{\frac{\bar{p}(1-\bar{p})}{50}}$. Any future point falling above this limit would indicate an assignable cause of variation. It is evident from the control chart that the quality improved steadily, enabling a reduction in the limit by the end of the month.

In the same manner other tube types were included in the program. A feeling of competition developed among the workers in the various production lines. Monitors began to be proud of their ever-lowering averages. Within two months a significant improvement in quality was apparent across the floor.

Report to Management; Evaluation

A very necessary step in promoting the program was to keep management informed peri-

. . . Continued on page 174

Accuracy ± .000008"

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43 BLOCK SET

Specially selected sizes for the small shop or a standby set where additional blocks are a needed convenience.

Keep a second set with wanted sizes available on instant notice. Avoids delay or even error that might result from using substitute gaging methods.

The 43 Block Set (43 B) has accuracy of ± .000008" and must pass the same test for surface finish, flatness and parallelism of the finest grade of steel blocks.

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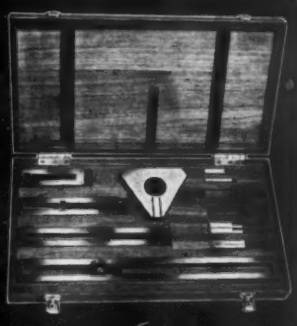
If you use gage blocks you'll want the time saving convenience of this accessory set. It simplifies gaging by enabling you to apply the blocks directly to the work as a snap and plug gage, height gage, scriber and trammell. The set includes 4 gage block holders, base, straight and round jaws, centerpoint and scriber.



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. . . Certification, from page 49

the goal of day to day manufacture must on some reasonable basis be attainable. This is why the somewhat revolutionary concept of an allowable amount of defectiveness is employed in Certification.

4. Agree Upon the General Control System the Supplier is Using or Will Use

This is to insure that the Quality levels he claims and wants to Certify can be truly produced on each and every lot of material he supplies. This may seem severe. It might appear as though an attempt is being made to dictate the supplier's control system. In actual fact, it is not that at all. It is necessary, simply, that the supplier's claimed ability to produce Quality should be backed up by a system which will automatically **single out any unacceptable lots of production and cause their correction before shipment.** This is another important area in which facts must rule instead of opinions. Even though a supplier may have excellent intentions and a good Quality history to support his claim of a top Quality product, he cannot Certify without deliberate and factual knowledge that each single shipment meets the Quality tests. We stress this because the Ford Motor Company depends on the Certification to produce exactly what it claims to produce, acceptable individual shipments. This is hardly too much to ask when the terms of our Purchase Order empower the rejection of a shipment which is in the least way defective, let alone defective to the extent of an agreed 1% or 2%.

5. Agree Upon Periodic Written Evidence from the Supplier

This will serve as proof that the above-mentioned control system is in regular and effective operation. This is found necessary because of the tendency of most of us to fulfill fully, only those responsibilities which are concretely charged to us. If, for example, a Certification were to set forth general responsibilities for supplier and consumer and then provide for no concrete discharge of these responsibilities, it would soon develop into a well intentioned but meaningless piece of paper.

This "documented evidence" as we call it, takes a variety of forms, depending on the nature of the part, but depending even more on the supplier's particular system for controlling Quality. It is an attempt to secure the supplier's own evaluation of outgoing Quality, an evaluation which is a logical and natural product of his system. If, for instance, he performs a sampling inspection on each of his outgoing lots (which is the recommended best verification to us) then it is a relatively simple matter either to enclose a record of that inspection with the shipment or to sum up periodically and furnish the summary. It should be added and emphasized that the supplier through the application of a **sound outgoing sampling plan,** can enjoy the immediate benefit of organizing such inspections as a principal tool for defect prevention. We are of the opinion, in this regard, that outgoing product sampling is the best kind of stimulant for Quality improvement. It proves the effectiveness or ineffectiveness of the entire internal system for Quality Control and regularly highlights the areas of most urgent need.

6. Conduct a Pre-Certification Trial

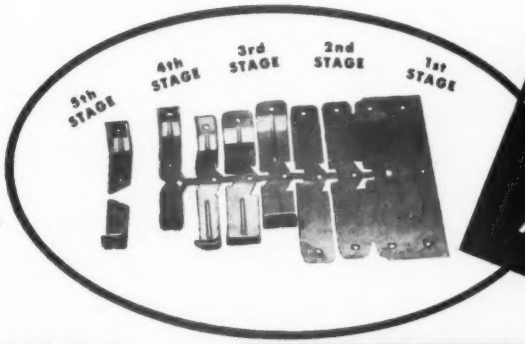
This establishes correlation of gaging and inspection methods, where necessary, and for a final test of the supplier's ability to meet all Certification requirements. The trial may take a month or, it may take longer, depending upon the supplier's record at the consumer's plant, the frequency with which he ships and his success in meeting the tests. Both the supplier and the consumer have opportunity during this interval to make any changes of system which may be required and to test the entire workability of the agreement.

7. Sign the Certification Agreement After the Trial Period

It is provided in our Certification Procedure that the Agreement, which becomes an attachment to the Purchase Order, should be signed by those the supplier might designate as responsible authorities, together with representatives both of Purchasing and Quality Control in our consuming division. The consumer thereby engages to accept and scrap or repair the defectives in any shipment which meets the test of the Acceptable Quality Levels. That is provided, of course, that any uncertified characteristics are not defective to a prohibitive extent. It is found in actual practice that there are occasional difficulties with characteristics of this kind which are not certified. These difficulties can hardly be anticipated and can only be dealt with on a case basis. Fractured metal, for instance, if not a condition which experience has shown to be a likely problem, does not appear as a part of the Certification. Again, it is a matter of focusing emphasis where there is the greatest likelihood of benefit. That is why some of our Certification Agreements consist of only 6 or 8 characteristics, in total.

As soon as full dependence may be placed on the Certification, our own inspection efforts are reduced to a minimum. We continue on either a cycle or a random basis to perform "audit" checks insuring that the shipments

. . . Continued on page 172

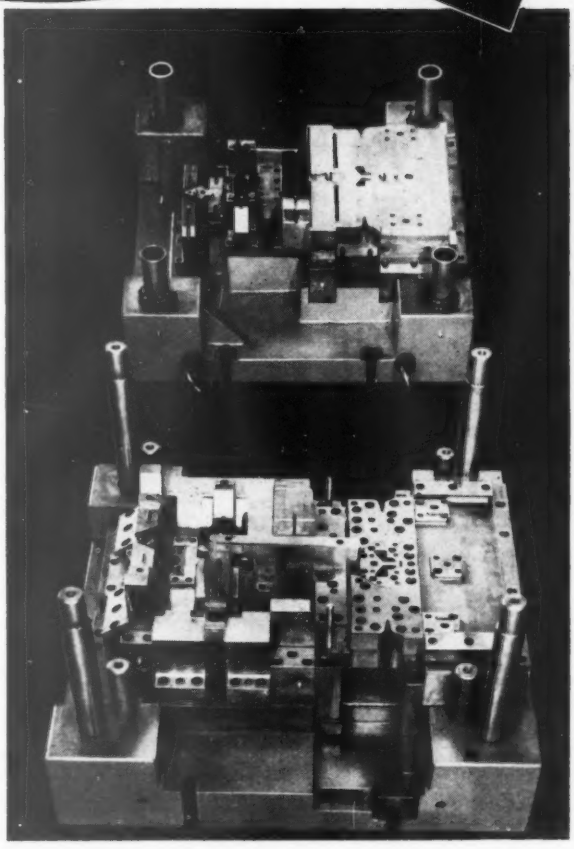


BEHIND THE SCENES of a TOP-RANKING AUTO BUILDER

5-STAGE BARTH DIE

assures low cost and high production of

FRONT BUMPER PANEL SUPPORTS!



HOLDING A TOP-RANKING position in a highly competitive automobile field requires constant search for better and lower-cost production methods.

This 5-Stage Barth Die, purchased by the maker of one of America's most popular, big volume cars, performs five precision operations as follows:—

1st Stage — Pierces 3 holes
2nd Stage — Notches openings
3rd Stage — Preforms — forms bead
4th Stage — Flanges side and front form
5th Stage — Cut-off, forms, flanges

Keeping abreast of competition is a "must" in today's industrial market . . . keeping ahead is even better, and the wide scope of Barth experience and facilities for developing and building exceptional tooling and special machinery, may help you achieve this enviable position. *Write for catalogue.*

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DESIGNERS AND BUILDERS OF DIES, TOOLS AND SPECIAL MACHINERY

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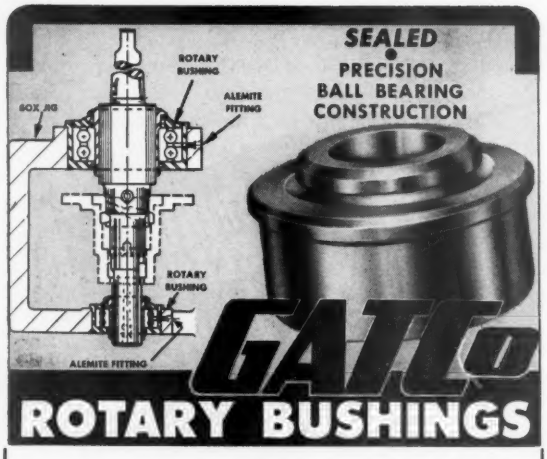

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DRILLING
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The inner race of the GATCO bushing rotates with the tool, piloting the tool accurately below or above the work—or both.

Eliminates expensive tool construction—Reduces tool wear —Prevents seizure and pilot breakage—Especially adapted where precision is required.

Write for full information and prices

GATCO ROTARY BUSHING CO.

42330 ANN ARBOR RD., U. S. 12, PLYMOUTH, MICH.

Telephone PLYMOUTH 1472

. . . Certification, from page 170

furnished under Certification meet the claimed levels of Quality. If the audit reveals defectiveness beyond the negotiated levels, we check a series of consecutive shipments for evidence of lack of control. The number of such shipments is actually stipulated in the Certification Agreement, with the further provision that the Agreement is to be terminated if these checks confirm the supplier's present inability to live up to the Certification. Termination is accomplished by written notice from the consumer and is made effective as of the date the discrepancy was first revealed. The supplier, too, may terminate the Agreement by written notice if for any reason he wishes to withdraw. Otherwise, the Agreement is effective as long as the Purchase Order, itself, is in effect.

The Ford Acceptance Sampling tables, previously mentioned, are illustrated in Figure 3. These are used as the basis for judging all incoming parts including those audited under Certification. They are specifically referenced in the articles of Certification and furnished to the certifying supplier. He then knows in detail and without any question how Ford makes its Quality determination on his product.

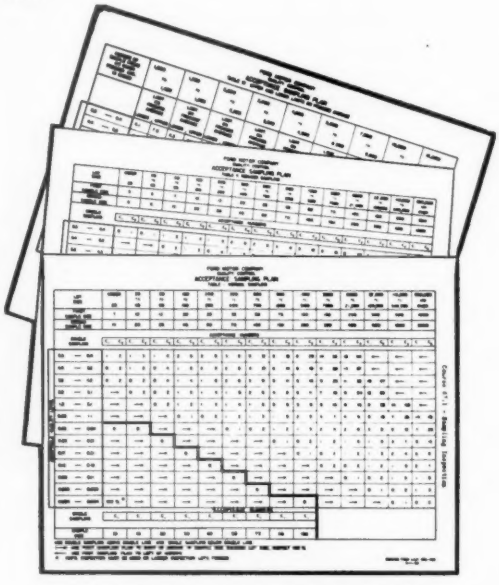


Fig. 3. Ford Acceptance Sampling Tables.

Earlier efforts to explain our approach to Quality included the circulation of a series of Ford training pamphlets on various phases of Quality Control to some 600 of our volume suppliers. One of these pamphlets was devoted completely to Quality Level Certification. During the same period we offered 1½ day in-

. . . Continued on page 174

. . . Splines, from page 89

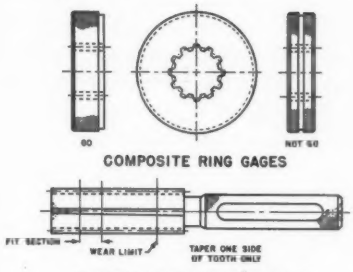


FIGURE 10

tions. It is, therefore, ideally suited for quality control operations. During production, the work can be checked accurately and quickly without removal from the machine.

The indicator snap gage has a fixed bottom jaw and a movable top jaw. Both jaws are provided with gaging anvils which may have the form of a rack tooth, or teeth, or a cylindrical section approximating a standard measuring pin. Anvils are interchangeable to accommodate different pitches.

The movable top jaw actuates a cushioned movement dial indicator graduated in increments of .0001 inch. The gage is set to zero with a set master. The reading on the dial indicator can be converted by a direct ratio to determine the difference between the tooth thickness of the part and that of the set master. This ratio is stamped on each gage as follows: ".XXXX" on indicator represents .XXXX" on tooth thickness." The set master can be made to the high, low, or mean tooth thickness or to incorporate any combination thereof.

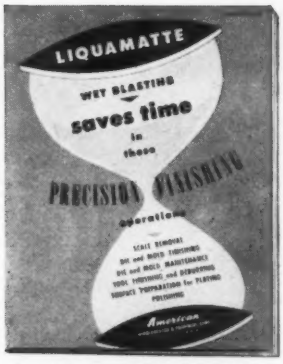
The Go composite ring gage, Figure 10, represents the mating internal splined part and controls the maximum effective tooth thickness. The Not Go composite ring gage is used only when the minimum effective tooth thickness is specified and not marked reference. (See Control Systems C102 and C103).

The tapered tooth master plug is used for the accurate control of the ring gage. The ring gage is fitted to the master plug at the fit section. It is allowed some wear, usually .0003 inch on space width. When it passes over the large end or a scribed line on the plug, the ring has worn beyond allowable limits and should be replaced.

This question is often asked: Why is a master plug recommended for controlling a ring gage, when a master ring is not recommended for controlling the plug gage? The answer is that all functional dimensions, including over pin size, spacing, lead, out-of-roundness and involute form, can be inspected on a plug

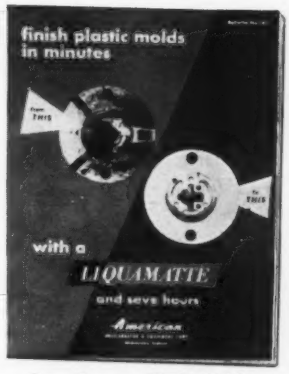
. . . *Continued on page 181*

how to cut precision finishing costs



Save Time on Tools, Dies, Molds.
Bulletin 43

Save Time on Glass Molds
Bulletin 53



Save Time on Plastic Molds.
Bulletin 63

The bulletins illustrated above show how tools, dies, molds, engine parts, etc. requiring 1 to 6 hours to finish by hand methods are now finished in from 30 seconds to 10 minutes in a Liquamatte Wet Blasting machine. They explain how manual operations are practically eliminated as dies, molds and cutting tools are cleaned and/or finished to tolerances of .0001".

Take the first step towards reducing your finishing costs and *send for one or more of these bulletins today.*

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LIQUAMATTE
WET BLASTING

Division of
AMERICAN GAGE and MACHINE CO.
SIMPSON ELECTRIC COMPANY SIZE CONTROL COMPANY
WALSH PRESS & DIE COMPANY

. . . Certification, from page 172

troductory training sessions on Quality Control to any of the same firms who might wish to send representatives. The response was most encouraging. A total of 693 men attended, and it was here, we feel, that the seed for many of our current Certifications was planted.

Summing up, we should review for a moment the benefits of Certification to everyone concerned. For the supplier, the principal benefits included (1) the advantage of knowing precisely what is most needed in the product, (2) the willingness of the consumer to absorb and repair a designated amount of defectiveness at his own expense, (3) the development of a realistic Quality evaluation of outgoing shipments, and (4) the competitive advantage of furnishing guaranteed Quality. The consumer benefits principally through the existence, for the first time, of a real system for Quality assurance. He knows that his supplier is concentrating his Quality efforts on the characteristics which most vitally affect Quality and that the frequency of his own receiving inspections can be reduced thereby.

Finally the public, who purchases the finished product, will benefit. Every industrial improvement, whether it is in the technology of manufacture or, as in this case, the system for improving Quality, has the primary end of customer value in mind. If Certification results, as it most assuredly does, in the more efficient concentration of suppliers and consumers on Quality, then its final advantage belongs with the customer.

The public with every purchase of shoe laces or of automobiles rightfully expects to buy Quality. When the lack of Quality facts prevents our products from performing as they were designed to perform and purchased to perform, then it must be agreed that the facts should be sought out and understood. Certification provides the answer.

. . . Providing Incentives, from page 168

odically of the progress being made. Figure 3 is a copy of the weekly report submitted which includes quality summaries of six tube types, with a breakdown of the defects found. A quick glance at several weeks' reports will reveal any important quality trends.

Although a gradual improvement in quality occurred on all tube types, this was by no means automatic. Diligent work, excellent cooperation, and resourceful planning on the part of the operators, monitors, and supervisors, and steady encouragement and support from management were the factors most essential for the realization of the original goals.

Hansford "DIE HANDLER" Speeds

Die assembly
•
Inspection
•
Maintenance
•
Servicing

Safe, easy handling of Dies or Molds. Accommodates Dies 24" x 43" weighing one ton. Other models available for larger sizes. Motorized lift, as shown, optional.

SAFE - STURDY - PORTABLE

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Men who had to "lick" the very problems you're facing designed... ROUSSELLE PRESSES

That's why they're fast, accurate, so adaptable, so easy to operate. Why maintenance is simple. Why initial cost is low . . . Often considerable savings and improved punch press operations are possible if you let our engineering staff assist you. There is no obligation. Simply furnish the details relating to your need or problem and if possible send samples or drawings of the work. You will hear from us promptly.

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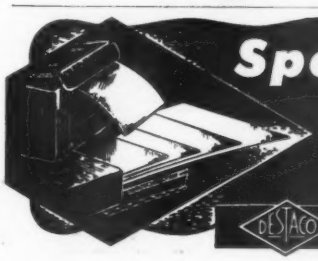

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Made from selected steel or brass, rolled to precision limits, oiled to resist stain and rust, free from burrs. Twelve assorted thicknesses .001" to .015", sheets 6" x 1", coils 120", identified every 6" by thickness and amount remaining on roll.

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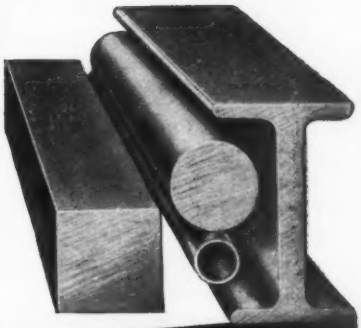
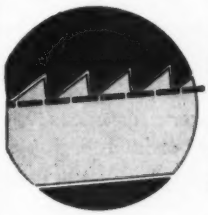
Atlantic
WAVY SET BANDS...



FOR FAST, ACCURATE GANG CUTTING!

Specially designed teeth clear away chips for speedier—cooler—precise cutting. Atlantic Wavy Set Bands have precision milled, even set teeth that slice through multiple drill rods, bar stock, I beams or tubing for gang cutting efficiency. Increased blade flexibility and uniformly heat hardened teeth make this—like Atlantic's complete saw line—supreme in durability, operating efficiency and dollar saving economy.

ATLANTIC QUALITY CONTROL STARTS HERE . . .



The band saw teeth — and *only the teeth* are scientifically hardened to guarantee the sharpest, keenest cutting edge. The entire saw body remains flexible. This precision heat treating increases blade life — saves blades, down time and dollars!

Atlantic engineered with a wave of teeth to the left, then to the right to sweep away chips during cutting. Saw operation is Free! Easy! Efficient! Better finishes result with no chips to score or mar work.

FREE!

This pictorial story on Atlantic Wavy Set Bands. Send for your copy today. Have you a specific band saw problem? Include a brief description and it will meet with interested engineering attention and will be promptly acknowledged.

Atlantic
ATLANTIC SAW MFG. COMPANY Inc.
158 Brewery St., New Haven, Conn.

SEE ADVERTISERS INDEX, BACK OF BOOK, FOR INFORM-A-GRAM KEY NUMBERS

. . . Press Room Q. C., from page 54

trical steels, enameling sheets, copper and aluminum base alloys, and a variety of coated sheets. Definite instructions are issued from the quality control office as to both the type and frequency of inspection procedures along with the limits for either acceptance or rejection. The inspectors are guided in their activity by a group leader who in turn is responsible to a section leader.

Thus, starting at the raw material stage, a representative sample is selected from the shipment for the acceptance test procedure; this sample being either checked dimensionally or sent to the appropriate laboratory within the company where the material may be tested as to its chemical composition, its mechanical properties or its electrical characteristics. As previously mentioned, where the material shipped is from a source that has a known quality level of acceptance, obtained either through previous shipments or by certification, testing procedures may be waived or intensified depending upon the degree of quality level that had been found in past shipments. Where the quality level of incoming shipments has been high in relation to the standards set by a specification, test procedures are at a minimum. Where a test procedure is performed, the results are given to the quality control office which in turn notifies the group leader as to rejection or acceptance.

Where the material is rejectable, the supplier is notified and given the reasons for rejection. In some instances, where the material in dispute is borderline, duplicate test procedures are made by an independent laboratory which is absolutely impartial; the results of these tests being used as the basis of either acceptance or rejection. In some instances, the material can be used for other applications which permit a lower quality level. This procedure is usually followed when the supply of the material in question is short. Subsequent shipments from this specific supplier are examined very closely for acceptance.

Where the material is acceptable, it is tagged with a blue marker indicating the date of acceptance, the supplier from whom it had been obtained, the date of shipment, the end use, and the signature of the inspector. Duplicate records are available in the office at the point of entry. In the control of actual press room operations, the initial stage of inspection is "first piece" inspection which, as its name implies, consists of thoroughly checking the first few pieces that come off a press after set-up has been completed. Production on the press set-up is halted while determining whether the part is either acceptable or rejectable.

If the sample parts have been acceptable, the foreman of the press room is notified and the production of the part is started. A tag bearing the date of "first piece" inspection, the blueprint number, the part name, the type of operation, and the signature authorizing production is placed on the machine that is assigned for the production work. The work that is produced is periodically checked by the roving inspector assigned to that area; the results obtained along with the time and date of

. . . Continued on page 178

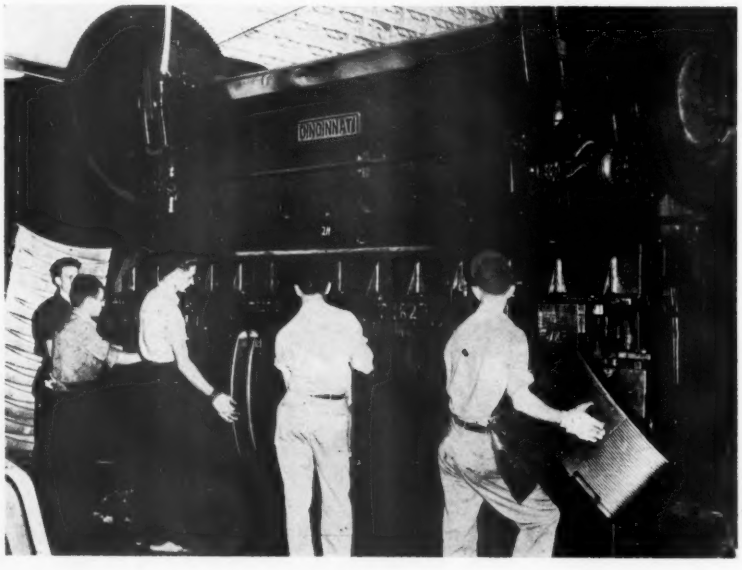
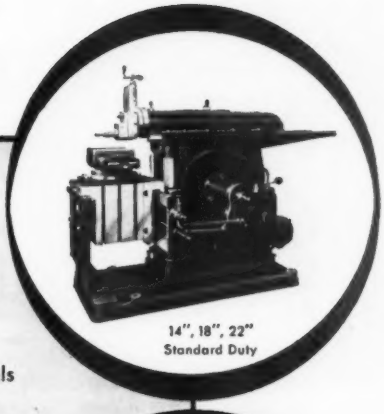


Fig. 4. Refrigerator door brake-formed in multiple setup. Production of this part requires close control to maintain dimensions.

VMA ... the finest in shapers!

Superb Swedish craftsmanship, plus fine design and construction backed by 50 years' experience, makes the VMA line of shapers outstanding production and tool room machines. Three sizes, in both the standard and heavy-duty models, cover a wide range of machining requirements. Simplified controls are grouped conveniently for the operator. Both standard duty and heavy duty models provide a generous selection of speeds and feeds. Table power rapid traverse is standard on heavy duty models. A rugged, swivel-base vise, motor and starter are standard equipment. You will be pleased with the modest prices and early delivery dates.



14", 18", 22"
Standard Duty

18", 22", 26"
Heavy Duty

Prompt delivery — Attractive Price — Write for Folder!

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You Get FASTER SERVICE

Our more complete stocks mean "at once" shipments of quality fasteners when you need them—no production delays—no maintenance "shut downs."

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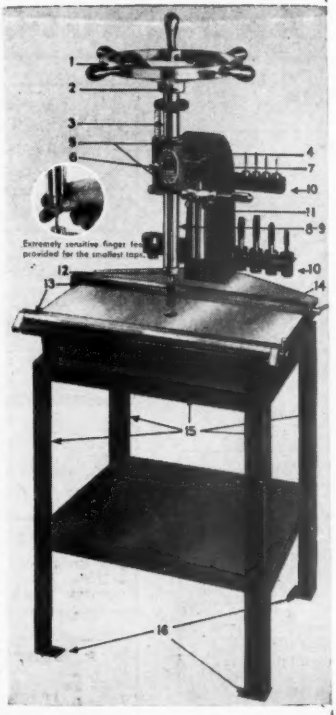
The finest hand tapping machine made. In use in hundreds of shops, universities, experimental rooms and governmental agencies. GOOD FITS, RIGHT ANGLE HOLES, tapped to correct depth with NO TAP BREAKAGE are achieved while using unskilled labor.

CHECK THESE FOUR EXCLUSIVE FEATURES

A machine carefully designed, COMPLETE with direct - reading DEPTH GAUGE (No. 3), quick-change TAP ADAPTERS (No. 12), capacity to 1", pipe taps to ¾", threading die holders to 1½", HOLDING BARS (No. 13), and our Universal TAP & DIE GUIDE (No. 11) for use on lathe or drill press.

Write for complete information on the various models



LASSY TOOL CO., Plainville, Conn.

. . . Press Room Q. C., from page 176

inspection and the signature of the inspector being placed on the tag. The frequency of inspection is dependent usually upon the tolerances that had been selected for the specific part along with the conditions of those variables of press set-up, condition of equipment, condition of tools, type of operation performed, lubricant employed, operator skill, and type of material being formed. Where a number of operations are required to produce the completed press-formed part, each operation is checked in the manner as described.

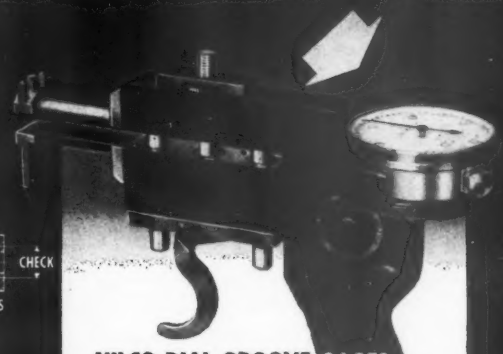
Where a specific operation fails to pass the standards set for acceptance, the cause of rejection is determined. This phase of quality control is quite important since it frequently identifies weak points within a specific tool set-up or operational procedure. This can be of use in the future when similar parts are to be made. In those instances where the objectionable feature is a burr, the job is halted until the tools have been sharpened. Or, the fault may be in excessive tool wear, the use of relatively unskilled help or improper set-up. Regardless of the specific fault, corrections must be made so that acceptable work can be realized.

Within the press rooms, facilities are available for the washing of parts and the annealing of press-formed parts. In the latter case, extensive annealing between draws is given to both steel and copper alloy draw-pieces; the cycles employed being recommended by the plant metallurgist. Although occasional checks are made by the metallurgical department, the inspector assigned to that area where the annealing furnace is located will frequently check the temperature of annealing. Since one of the furnaces employed is of the continuous type for the bright annealing of electrolytic tough-pitch copper, the inspector also checks the degree of brightness of the drawn shells as they emerge from the furnace. As is dictated by the type of operation, initial determination of both furnace cycle along with composition of protective atmosphere is made by the metallurgical department; however, the inspector is trained as to the standards that are required. Any serious variations observed, which may be related to the efficiency of furnace annealing, are at once brought to the attention of the plant metallurgist.

Periodic checking as to the cleanliness of press-formed parts as they emerge from the spray washer is an additional duty of the inspector assigned to that specific area; the solution strengths being checked periodically by

. . . Continued on page 180

now simply READ groove diameters



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CHECK BLIND HOLE

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CHECK SPECIAL GROOVES

NILCO DIAL GROOVE GAGES

enable anyone to check groove diameters rapidly and accurately. These gages pay for themselves by reducing manufacturing and inspection costs.

Check grooves from ½" to 5". Write for Catalog DG. Submit drawing for quotation.

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Gages available for checking "O" Ring, Truarc and other retaining ring grooves.

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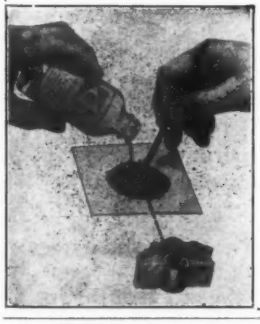

For Retaining Drill Jig Bushings
Use B-K # 7 CEMENT

No distortion of the jig plate or misalignment of the hole pattern. Eliminates lapping of press fit bushings after assembly. Not affected by drilling heat. Bushings can be retained in steel, aluminum or fiberglas jigs. Easily applied by untrained personnel. Especially recommended for use in "master tooling" operations.

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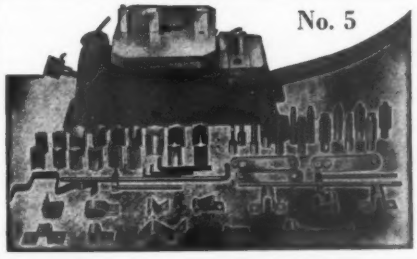

No. 5

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BENDER-CUTTER
CUTS, BENDS, PUNCHES

Available in hand or air operated models, the MULTIFORM is shipped complete with full assortment of dies and mandrels to form and cut round or flat stock up to ⅛"x1½" as illustrated. Punching and round end blanking dies available. Other models up to ¼"x 4" air operated.

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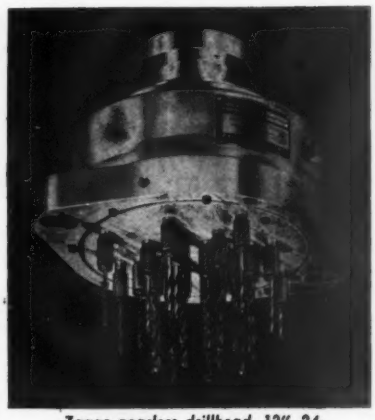

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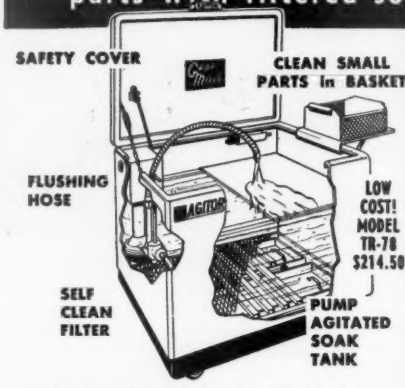

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Dahlstrom TAP GUIDE

. . . Press Room Q.C., from page 178

a chemist and suggestions for additions given to the inspector responsible for this operation. This factor of cleanliness is of tremendous importance, especially influencing the brightness of subsequent annealed copper shells and the corrosion resistance of shells that have been press-drawn from stainless, type 302. In the latter case, inspection of stainless under black light is frequently made to check chemical cleanliness, since any soil, even fingerprints, will cause the formation of harmful carbides during annealing, resulting in a loss of corrosion resistance.

As is indicated, the duties of the inspection force in one press room, which is devoted to diversified production, are indeed varied. In basic press activities, the inspector not only checks dimensional factors, but also those factors, set by the quality control office, such as material type, gage and hardness; the usage of the recommended lubricant type and concentration, and actual press set-up. In addition to the master gages to determine dimensional values, the inspection group leader has an approved sample of the part being formed along with a unit part representing each operational procedure.

Where the production requirements are exceptionally high, as would be exemplified in the production of the "Coffeematic," the press operations are incorporated into a straight line production unit. Thus, in a newly developed set-up, operational procedures from raw material to finished product constitute straight line production which necessitates inspection procedures which differ to some extent from those previously described. Although periodic inspection of unit press operations continues as before, the essential difference in inspection procedures is the establishment of sampling stations at critical points.

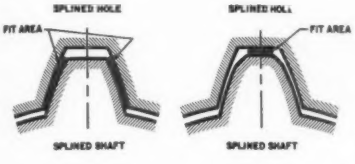
Where difficulty in press operations is experienced which is beyond the scope of the individual inspector, the plant metallurgist is requested to determine the cause. In many instances, material, which appears to be of satisfactory quality at the raw material inspection, may have hidden defects which are detected during press working. An example of this is the surface lamination marks which may show up during a press drawing operation. When this occurs, press operations are halted and the issued material carefully examined to determine the extent of this defect. The material is set aside and the supplier contacted; the material being held until a decision as to the disposition of the material has

. . . Continued on page 182

. . . Splines, from page 173

gage. The inspection of these same dimensions on a ring gage presents many difficult problems. In addition, master plugs can be made with tapered tooth thickness to check the wear of the ring while it would be extremely difficult, if not impossible, to manufacture tapered tooth rings. Therefore, the practice of fitting rings to a master plug is generally accepted. In order to prove the acceptability of a master ring, it would, in most cases, be necessary to check it with a master plug.

The basic group of gages — plug, paddle plug, ring and snap — that are necessary for checking a splined connection using the tooth side fit, the most common type of fit, have been discussed.



TOOTH SIDE FIT MAJOR DIA. FIT

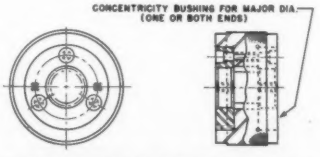
FIGURE 11

When a major diameter fit is encountered, (see Figure 11) gages and gaging elements for the inspection of critical fit diameters must be added to the basic group. Proper and complete dimensioning of fillets and chamfers is important for this type of fit.

On major diameter fits, it is necessary to control the concentricity between the major diameter and the pitch diameter of the splined connection. This is generally accomplished by using major diameter concentricity gages, Figure 12, which are capable of determining the acceptability of the part. Standard composite plug and ring gages are sometimes used in addition to concentricity gages to determine the cause for rejection, which might be either the effective size of the spline or eccentricity of the major diameter with respect to the spline.

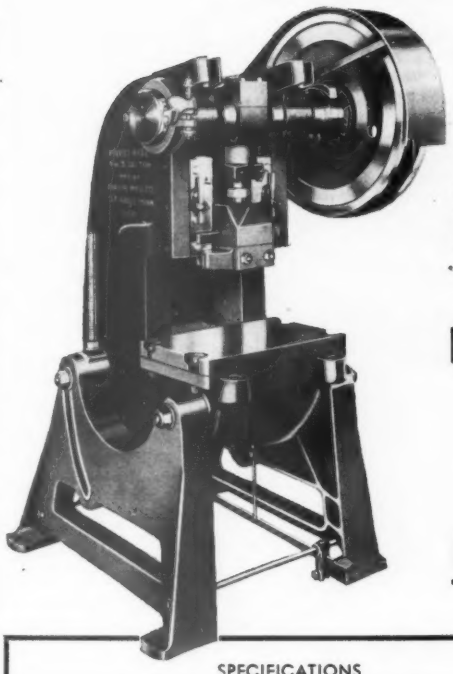
. . . *Continued on page 188*

COMPOSITE PLUG GAGE WITH MAJOR DIA. SECTION



COMPOSITE RING GAGE WITH MAJOR DIA. CONCENTRICITY BUSHINGS

FIGURE 12



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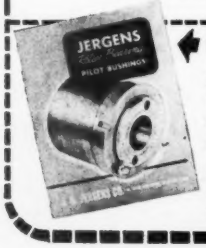

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. . . Press Room Q. C., from page 180

been obtained. In other instances, the difficulty is not quite as obvious, with the result that a thorough investigation is required.

In regard to the tools employed for statistical quality control, they should not be used within the press room. The only exception to this rule is the use of the frequency distribution chart; this being used only where the unit part requires exceptional close dimensional control, or where the tools are borderline in the maintenance of dimensions. In these cases, more frequent inspection is also required; the chart employed enabling both the inspector and the foreman to visualize the trend during the production of the run. The use of the chart will convince the foreman and also avoid dispute when a decision has been made by the inspector that either new tools are required or that the tools require re-dressing.

However, the tools of statistical quality control should be employed by the quality control office; the sequential sampling plan frequently being used on production lots to obtain the required information in evaluating the control level of a specific part produced under a known set of conditions. A plan of evaluation may be carried on a weekly basis or even more frequently, depending upon the quality level required. The group leader and the foreman of the department analyze the results and determine procedures for the improvement of the quality level.

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SAVINGS BONDS

As previously stated, the quality control tools, although an essential part of any quality control program, should not be employed in the press room, especially in the presence of the press operators. It may lead to confusion, and where a complete understanding is lacking as to the objectives of the quality control devices, suspicion and finally rejection will result. Cooperation is essential in any quality control program; this being obtained from the foreman through education and the actual increase of efficiency of his room as reflected in fewer rejections and greater output of high quality goods. As to the press operator, cooperation can be obtained by increasing take-home pay and, an ultimate goal, by developing a pride of workmanship.

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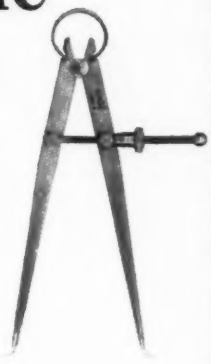

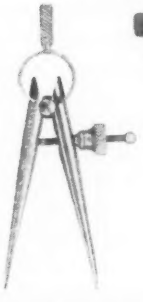
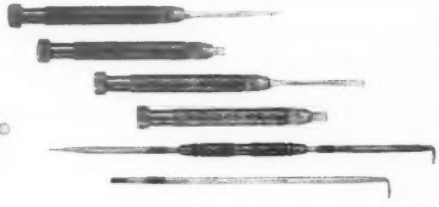

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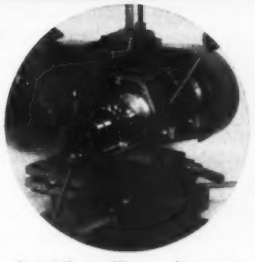

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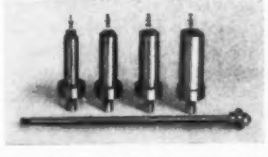

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. . . Statistical Q. C., from page 68

a new residual value. This was then used to test the main effects.

The significance of the E and F main effects was such that there was one chance in six that we might have reached such values by chance. Therefore it was decided to continue with the further experiment to attempt to resolve the E and F effects. The D main effect, however, was significant at the 5% level which means that there was less than one chance in twenty that the value of the F ratio could be obtained purely by chance. Since this is a standard which is ordinarily used for decision, we could then go back into one of the two-way tables and determine what the best value of the D levels were for our purpose. When we did this, we found that level 2 gave us the most desirable results in the area in which we wished to work and that statistically there was no difference between level 2 and level 3 demonstrated by this experiment.

It was now possible for us to proceed with Experiment 3. Since we wished to check on factors E and F, but only on two levels of each of them and also on factor G, we decided that we could afford to replicate six times, thus greatly increasing the sensitivity of the experiment. This then required a total of 72 tests for this third and final experiment. Since the calculations for this experiment followed a pattern similar to that of Experiment 2, I have not included the data for the first stages of the analysis. Instead, Figure 7 shows only the Summary of Variance Table for this analysis.

As can be seen, factor E still does not reach significance. As a matter of fact, the probability is less that it does have a significant effect than it appeared to be in the preceding experiment. Factor F, however, comes out to be very significant, as does factor G, and it was therefore possible for us to choose level 1 in factor F, and level 2 in factor G, as giving us the most desirable result. Having thus obtained the best levels of the different factors which entered into the final variation of our process we proceeded to make a production run on a number of tubes, using this best combination of factors.

SUMMARY OF VARIANCE

Source	Squares	df	Mean Squares	F Ratio
E	6,235	1	6,235	1.62 (1/67) 25%
F	18,762	1	18,762	4.90 *(1/67)
G	37,194	2	18,597	4.85 *(2/67)
EF	3,511	1	3,511	not significant
EG	4,174	2	2,087	not significant
FG	12,861	2	6,430	1.69 (2/60) 20%
EFG	7,644	2	3,822	not significant
Residual	226,569	60	3,809(3832)	
Total	318,950	71		

Fig. 7. Analysis of Experiment III.

The results were extremely encouraging. Our process produced tubes which were better than the current procedure so far as initial testing was concerned and to date have shown up much better than normal production in our life testing. In addition the time of the operation has been reduced materially. This is always advantageous in any production operation where the quality of the product is as good or better with the new process as it was with the old.

By using this method of small preliminary experiments, and weeding out main effects and different levels of main effects which did not prove to be significant causes of variation, we were able to obtain all the information we needed about this new process with a total of 180 experiments, in comparison with the over 6500 that would have been required had we run a full factorial experiment on the initial list of factors.

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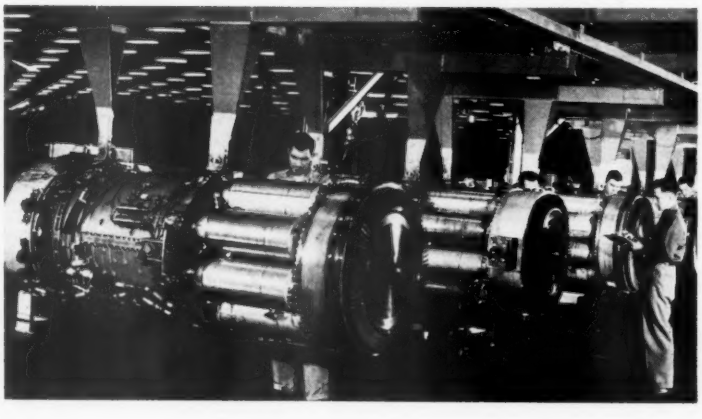

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No. 160	Precision adjustment heavy duty duplex magnetic base holder, pull, 125 lbs.	$17.75
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Hydraulic Press and Index Table Solve Two-Fold Production Problem

A Special Story on Wells Manufacturing Co.

A production man knows he has really accomplished a worthwhile feat when he can look at a successful tooling setup made years before that is still proving its efficiency.

Such is the case at The Wells Manufacturing Company, Fond du Lac, Wisconsin, one of the world's largest makers of distributor rotors for internal combustion engines.

For years the assembly of the plastic rotor body and its metal contacts was a difficult and uncertain procedure.

A flat steel spring and a brass distributor lug

Fig. 1. A girl operator picks up the three pieces of a rotor assembly from trays and places them in the fixtures of the rotating index table which carries them under the hydraulic ram and the two-stage milling operation.

are riveted to an ear of the plastic rotor head which mounts on the keyed rotor shaft in the distributor. Upsetting the rivet, which is cast in the plastic, so as to insure extremely snug anchoring of the two metal parts, is touchy. Too little pressure produces a sloppy union; too much of a blow shatters the relatively fragile plastic.

The original method of assembly incorporated a drill press with a spinning head and a small fixture mounted on the table. This method resulted in extremely uneven pressures, and caused the shattering of many parts; rejects for loose fits and broken pieces ran high. A separate tooling on another drill press handled the milling of the rotor contact. Production totaled only 302 rotors per hour.

Wells' engineers began actively seeking a means of increasing production figures and at the same time reducing the serious reject problem.

It was necessary to find a method that offered exact control of effort to prevent breaking the plastic rotor body, yet at the same time insuring a solid assembly.

As a result Wells' turned to hydraulics which

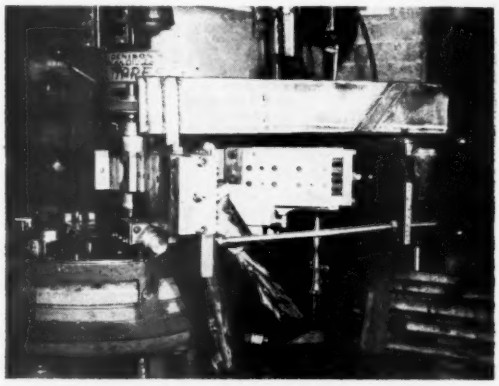


Fig. 2. These two electrically-driven miller heads are mounted at the first and second stations past the ram of a hydraulic press used by Wells Manufacturing Company, in assembling distributor rotors. The index table is tooled at six stations and is locked in perfect synchronization with the press.

appeared to provide all the needed factors of control. A 6-ton "Multipress," manufactured by The Denison Engineering Company, Columbus, Ohio, and equipped with a Denison Hydraulic Index Table was selected as the tool to handle the job. To this equipment was added two electrically-driven miller heads mounted at the first and second stations past the ram of the Multipress.

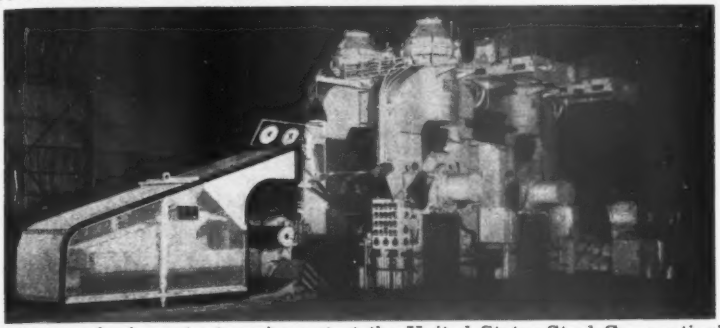
The index table is designed as a permanent base for tooling and fixtures, yet it is engineered to permit the easy interchange of tooling from one job to another. For this job, the index table is tooled at six stations.

The Denison Index Table is locked into perfect synchronization with the Multipress since it is powered directly from the hydraulic system of the press itself. Once the proper speed of press operation is determined, accurate control of the press and index table may easily be preset.

An operator places the three-piece rotor-contact assembly in tooling fixtures at a point on the index table directly opposite the ram position. Once the rivet is upset, the table indexes, bringing the brass lug into its first milling position. This stage of the assembly-finishing operation is controlled by a pin at the edge of the index table which acts as a micrometer, controlling the depth of the cut within .005 to .010". After a second milling operation, this same pin trips the air-ejection mechanism which removes finished assemblies from the fixtures.

. . . *Continued on page 194*

U. S. Steel Installs Bliss Two-Stand Tandem Tin Temper Mill



Among the important equipment at the United States Steel Corporation's huge new Fairless Works in Morrisville, Pennsylvania, is this Bliss 2-stand tandem tin temper mill and tension reel, 19" & 53" x 48". The mill is designed to operate at a maximum speed of 3740 fpm. A crew of only three men is required.

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FOR HIGHEST REQUIREMENTS OF ACCURACY

Accuracy	.00002"
Scale	.0001"
Easily read to	.000025"
Measuring pressure	6½ ozs.
Largest meas. height	7.87"
Distance from column	4.5"
Flat table	4.9" x 5.5"
Round table dia.	4.7"
Weight	approx. 50 lbs.

Available with flat or round table.

- No gears or pivots used.
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- Not affected by temperature.
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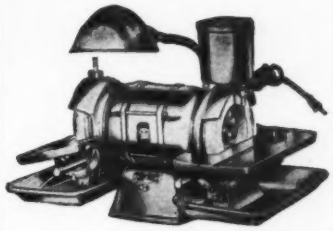

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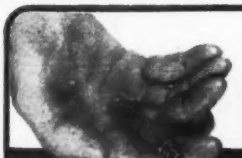

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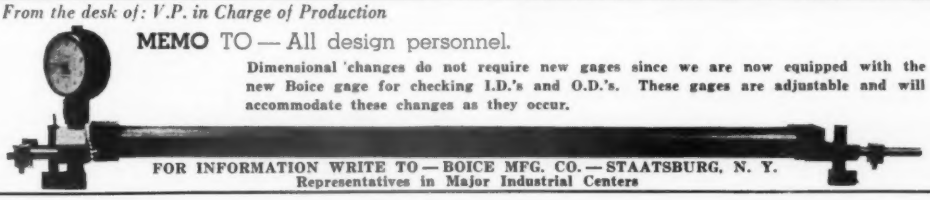
From the desk of: V.P. in Charge of Production

MEMO TO — All design personnel.

Dimensional changes do not require new gages since we are now equipped with the new Boice gage for checking I.D.'s and O.D.'s. These gages are adjustable and will accommodate these changes as they occur.



FOR INFORMATION WRITE TO — BOICE MFG. CO. — STAATSBURG, N. Y.
Representatives in Major Industrial Centers

. . . Splines, from page 181

The gages described above are effective in spotting production problems caused by faulty or worn tools, poor set-up or worn machines. For example, it is conceivable that a part will accept the Go snap gage, and the Not Go snap may have a tendency to start on the part, but the Go composite ring gage will not accept the part. This is a clear indication that either the interference errors are greater than print specifications allow or the ring gage is hanging up on an excessive fillet.

A typical chart is shown, Figure 13, that lists the factors involved on

	MACHINES TOOLS	PART SPECS.	GREEN GAGES	TYPE	FINISH GAGES	INVOLUTE SPLINE	REMARKS
SPLINED HOLE PART NO. 67471	BROACHING MACHINE NO. BC-671 BROACHED TOOL NO. T-74 LAP TOOL NO. T-75	MAX. ACTUAL SPACE WIDTH .0810 MIN. ACTUAL SPACE WIDTH .0800 MAX. EFFECTIVE SPACE WIDTH .0795 MIN. EFFECTIVE SPACE WIDTH .0785	TOOL NO. TOOTH THICKNESS TOOL NO. TOOTH THICKNESS TOOL NO. TOOTH THICKNESS TOOL NO. TOOTH THICKNESS HIGH LOW TOOL NO. TOOTH THICKNESS	NOT GO PADDLE PLUG GO PADDLE PLUG NOT GO COMPOSITE PLUG TAPERED TOOTH COMPOSITE PLUG GO COMPOSITE PLUG	TOOL NO. G-11 TOOTH THICKNESS .0810 TOOL NO. G-12 TOOTH THICKNESS .0795 TOOL NO. TOOTH THICKNESS TOOL NO. TOOTH THICKNESS HIGH LOW .0800 .0785 TOOL NO. G-10 TOOTH THICKNESS .0785	TYPE OF FIT FLAT ROOT SIDE MAJOR DIA. CLEARANCE MAX. .029 MIN. .014 BACKLASH MAX. .0061 MIN. .0005 MINOR DIA. CLEARANCE MAX. .0295 MIN. .014	ONLY SPLINES WITH BROACH TOOL TEAR MARKS ARE LAPPED.
SPLINE SHAFT PART NO. 67432	HOBBING MACHINE NO. BC-982 HOB TOOL NO. T-79 SHAVING MACHINE NO. BC-410 SHAVING TOOL NO. T-91	MAX. ACTUAL TOOTH THICKNESS .0784 MIN. ACTUAL TOOTH THICKNESS .0749 MAX. EFFECTIVE TOOTH THICKNESS .0780 MIN. EFFECTIVE TOOTH THICKNESS .0765	SNAP GAGE NO. G-15 SET MASTER NO G-16 T.T. .0814 SNAP GAGE NO. G-19 MASTER NO. G-20 T.T. .0799 RING GAGE NO. G-17 MASTER NO. G-18 T.T. .0827 W.L. .0830 RING GAGE NO. MASTER NO. T.T. W.L.	GO SNAP GAGE AND SET MASTER NOT GO SNAP GAGE AND SET MASTER GO RING GAGE AND TAPERED TOOTH MASTER NOT GO RING GAGE TAPERED TOOTH MASTER	SNAP GAGE NO. G-10 SET MASTER NO. G-11 T.T. .0784 SNAP GAGE NO. G-14 MASTER NO. G-11 T.T. .0749 RING GAGE NO. G-12 MASTER NO. G-13 T.T. .0777 W.L. .0780 RING GAGE NO. MASTER NO. T.T. W.L.	SPLINE DATA NO. OF TEETH 16 PITCH 20/40 P.A. 30° PITCH DIA. .8000 DRN. CKD. DATE	VINCO CORP SPLINED CONNECTION CHART PARTS 67471 67432

FIGURE 13

SPLINE DATA

16 TEETH
6/12 PITCH
30° P.A.
2.667 PITCH DIA.

EFFECTIVE FIT (BACKLASH) BETWEEN MATING PARTS .0005 TIGHT TO .0025 TIGHT

	SPLINED HOLE SPACE WIDTH		SPLINED SHAFT TOOTH THICKNESS	
HIGH RANGE	MAX. DIMN.	.2639	MAX. EFF	.2644
	MIN. DIMN.	.2629	MIN. EFF	.2634
	MAX. EFF	.2629	MAX. DIMN.	.2629
	MIN. EFF	.2619	MIN. DIMN.	.2619
LOW RANGE	MAX. DIMN.	.2629	MAX. EFF.	.2634
	MIN. DIMN.	.2619	MIN EFF.	.2624
	MAX. EFF	.2619	MAX. DIMN.	.2619
	MIN. EFF.	.2609	MIN. DIMN.	.2609

FIGURE 14

the fit control of splined connections. It includes part specifications, gage tool numbers and sizes, tools such as broaches, hobs, cutters, etc., and their identification numbers. Included also is the important fit information such as minimum and maximum major diameter clearance, minimum and maximum backlash, and all other important spline data. Space is provided for listing "green gages" which may be needed before heat treatment or before a final operation such as grinding. A section is provided where any unusual information pertaining to a particular connection can be listed. Charts of this nature can be used as a "central source of information" on any spline program.

As an example of what can be done with a properly engineered spline gaging program, let us look at a problem that confronted a large farm traetor manufacturer.

Figure 14 shows a spline design that calls for close tolerances—only a total of .002 for the effective fit between two parts. The required manufacturing tolerances are greater than the permissible variations.

In order to insure the desired fit and maintain interchangeability, it became necessary to set up a high and low range into which the parts must be selected. Note that if the extreme of the tolerance is used, the desired fit would not result but the effective dimensions provide the specified condition. This can be done since it is possible to approximate the amount of interference errors that will occur with any known method of production. Since

. . . *Continued on page 190*

INSPECTION FLOW CHART FOR SPLINED HOLE

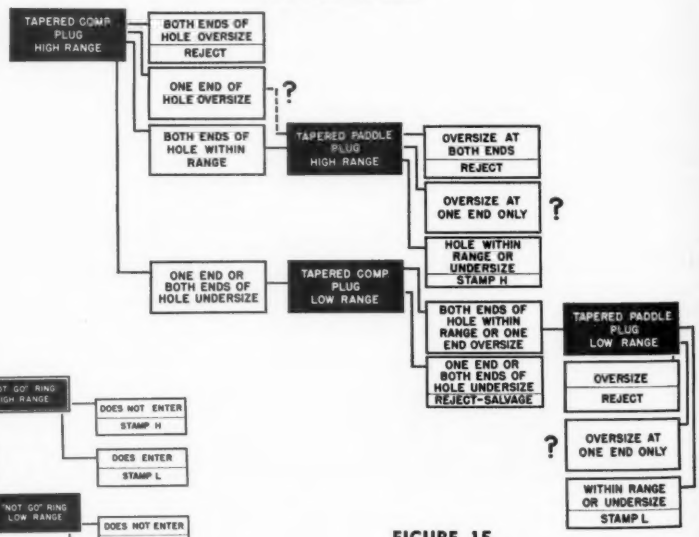

TAPERED COMP PLUG HIGH RANGE
BOTH ENDS OF HOLE OVERSIZE
REJECT
ONE END OF HOLE OVERSIZE
?
BOTH ENDS OF HOLE WITHIN RANGE
TAPERED PADDLE PLUG HIGH RANGE
OVERSIZE AT BOTH ENDS
REJECT
OVERSIZE AT ONE END ONLY
?
HOLE WITHIN RANGE OR UNDERSIZE
STAMP H
ONE END OR BOTH ENDS OF HOLE UNDERSIZE
TAPERED COMP PLUG LOW RANGE
BOTH ENDS OF HOLE WITHIN RANGE OR ONE END OVERSIZE
ONE END OR BOTH ENDS OF HOLE UNDERSIZE REJECT-SALVAGE
TAPERED PADDLE PLUG LOW RANGE
OVERSIZE
REJECT
?
OVERSIZE AT ONE END ONLY
WITHIN RANGE OR UNDERSIZE
STAMP L

FIGURE 15

INSPECTION FLOW CHART FOR SPLINED SHAFT

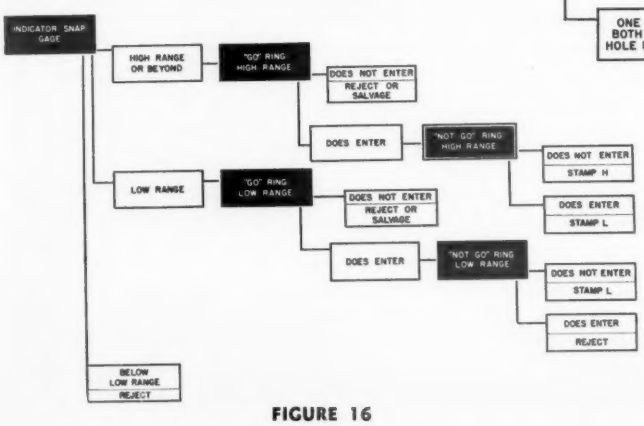


FIGURE 16

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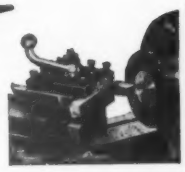
The three photos at right illustrate the flexibility of 12-position indexing, whereby each tool may be used in three different working positions.



¾" square tool bit mounted in Model 4½-S turret used for facing cut.

√Accurate within .0005.

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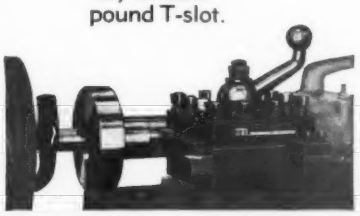

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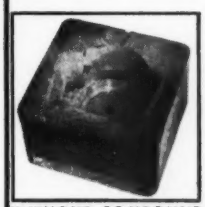

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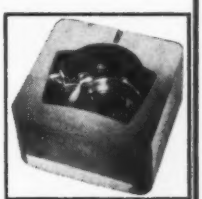

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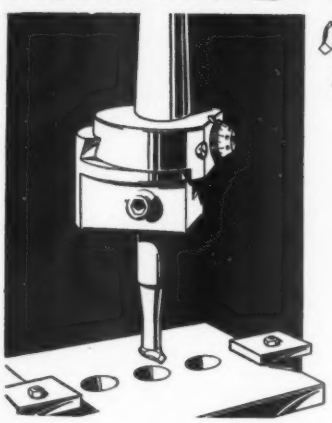

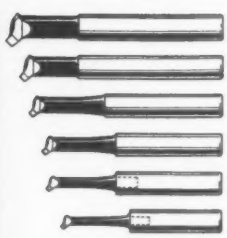

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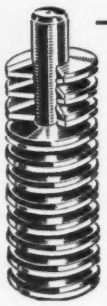

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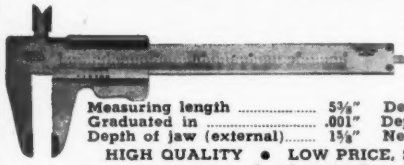

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. . . Splines, from page 188

the amount of press fit was all important in this event, it was necessary to provide gages that would insure against the parts being "too good." This was taken care of by using the Not Go composite gages. (Control System C102).

Gaging of this nature becomes somewhat involved and, therefore, it was necessary to provide inspection flow charts (Figures 15 and 16). These flow charts establish the sequence of gaging operations and show the disposition of the part for each possible gaging result. The various possible routes may lead to classification as high range "H", low range "L", to rejection or salvage. Where the final decision on the fate of the product is left to a salvage committee, a question mark is shown in Figure 15.

Flow charts of this character may be found extremely helpful in eliminating confusion from the interpretation of inspection results.

Inasmuch as each manufacturer generally has an individual gaging problem, we do not claim that the gages discussed will handle all situations nor that all the gages shown are needed for every spline gaging program; but it is hoped that we have been able to bring about a better understanding of the problems involved.

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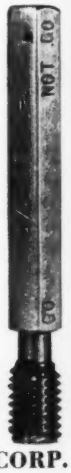

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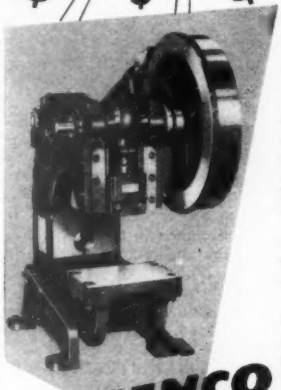

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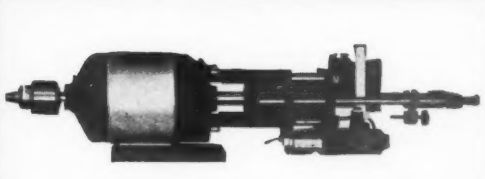

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Superior diamond quality combined with new bonding formula.

STAR DUST Laboratory graded Pure Diamond Powders

STAR DUST Laboratory graded diamond lapping compounds in 18 gram applicator gun—or in 5 gram ophthalmic tipped tube.

You can put your confidence in the STAR DUST line as so many others do because STAR DUST quality is consistent quality—the result of our special process of laboratory crushing and grading to achieve uniform nodular shape. That means *all* particles work for you. Be "Laps Ahead." For easier grinding and mirror finishes specify STAR DUST products.

For complete information and catalog write Dept. C-11

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10" to 48" are more buy for less money!

1. Adjustable Vernier TWICE as large as ordinary Verniers.
2. Longer Slide
3. Heavier Base
4. Greater Accuracy

IMMEDIATE DELIVERY FROM STOCK

also FOSTER 6" to 96" Precision Vernier Calipers

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New 16 PAGE

Catalog-Price List covering hundreds of stock standard precision plastic charts for every make and model of projector and comparator.

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BATTLE CREEK, MICHIGAN

There's a reason 76%* of all popularly-priced Tool and Cutter Grinders sold in 1952 were "Knock-Outs"

MODEL B860

Will do anything that machines costing 2 or 3 times more will do . . . yes and in less time.

Distributed Only Through Franchise Dealers

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Iron Lung for Metal Patients

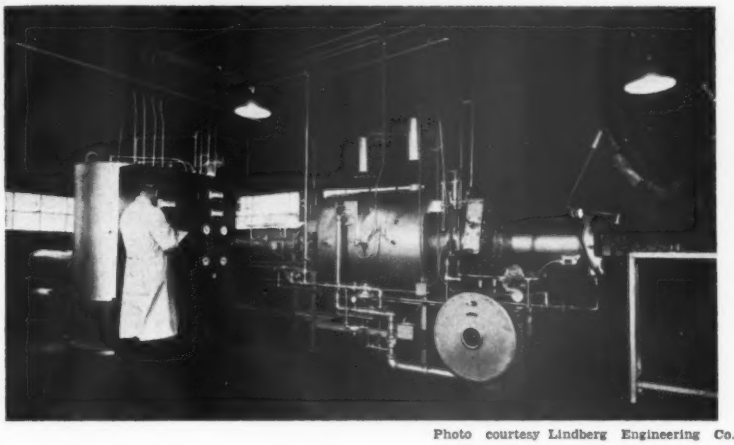
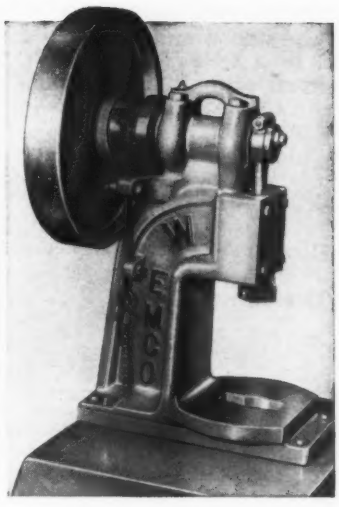


Photo courtesy Lindberg Engineering Co.

In the past, heat treating of stainless steel has often made the metal "ill," as well as the heat treater, by turning a part either black or dark green through oxidation. Cures such as pickling, sandblasting, etc., often aggravated this illness by a tendency to disturb the balance of alloying elements.

The General Metal Products Co., St. Louis, purchased an "Iron Lung," informally named because of its resemblance to units used for infantile paralysis patients, to cure their patients—baskets of partially completed deep-drawn stainless steel stampings of the type 305, 18-8. This furnace is also used to heat treat stainless steels in the 400 series. The unit is a full muffle, gas fired hydrogen atmosphere furnace with a water-jacketed cooling chamber.

Doctor's reports from this plant showed an immediate improvement in the color of the patients, each stamping emerging from the "Iron Lung" treatment bright and scale free with their original sparkling finish.



Emco "W", bench type. Also Emco "X" (larger size). Both sizes also stand-mounted. With or without motor drive.

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Two Practical Sizes

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Specials to order

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STOP DUSTS INSTANTLY

with

DUSTKOP

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300 cfm to 10,000 cfm

Ask for Catalog 605-2. Describe dust problem for recommendation by return mail—No Obligations.

AGET-DETROIT CO.

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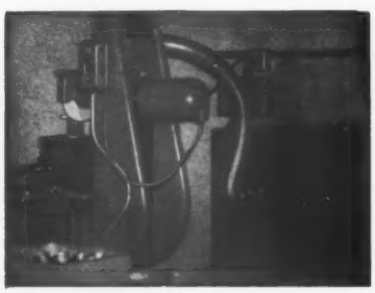


INTERNAL THREADING TOOLS for PRECISION THREADING

FOR HOLES FROM 1/16" UPWARD
17 DIFFERENT SIZES
MADE OF SUPER-HIGH-SPEED STEEL SPECIALLY TREATED
(Available in Carbide)

- CONSTANT SHAPE AND CLEARANCE
- EASY RESHARPENING
- CONVENIENT TO USE - LONG LIFE

Write For Complete Data

COMET Tool Co.

Dealers! Here's a Profit-Maker!

738-T Broadway
New York 3, N. Y.

. . . Hydraulic Press, from page 186

The second miller finishes the trimming operation to a tolerance of .001". This operation is micrometer controlled. A cam-follower and guide are incorporated into the tooling to facilitate this control.

This single Multipress and index table installation is now turning out completely assembled and milled rotors at the rate of 800 an hour, a 166% increase over the former drill press method. Further, rejects due to broken or loosely-assembled parts have been eliminated.

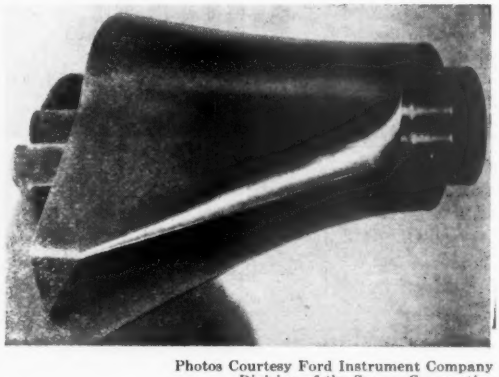
Commenting on the operation, Mr. Lee F. Sickler of Wells, said the press has been in operation nine hours a day, 5 days a week, for the past 4½ years, and has never required maintenance. This, naturally, has added greatly to the efficiency of the operation.

Although labor and materials costs have continued to rise during the postwar period, this assembly and milling operation has been so efficient that Wells has not been forced to increase their price on the part in the last 8 years.

Mr. Sickler added: "This Multipress is the reason why we now have a large part of the rotor business."

3-D Cams

In the production of three-dimensional cams, Figure 1, by the Ford Instrument Company as many as two thousand data points are end-milled in order to set precisely the contours of handcut masters.



Photos Courtesy Ford Instrument Company Division of the Sperry Corporation

Fig. 1 Two thousand data points set contour of three-dimensional navigational cam manufactured by Ford Instrument Company.

In one group of highly complicated computing mechanisms being built for the Air Force, in which many mechanical and electrical devices process their data through navigational cams accurate fabrication is essential. To be certain that all production cams duplicate their masters in every respect, the Ford Instrument Company designed and built several pantograph-type cam-cutting machines, Figure 2, which can work to ±0.0002" tolerance.

Each three-dimensional cam must be able continuously to sustain, without significant yielding or wearing, the live load introduced by a highly-pressurized stylus. To meet this requirement, the cams are made of Meehanite, which provides good qualities of machineability, edge-strength, and wear. In addition, they are fabricated to ±0.0005" tolerance, and hand-polished to produce a 20 micro-inch surface.

Once taken from their cast, the cams are heated to their sub-critical (1250° F) to give stress relief; thermal stresses are subsequently minimized by furnace cooling. Then the ends are rough-sanded and milled, collars turned, and holes drilled.

Two shaping cuts are usually sufficient: the rough cut takes down about 0.125", and the finish cut down about 0.010". These operations are followed by dimensional inspection, hand-polishing, and another dimensional inspection. Then the cams are rust-proofed by boiling in a ten percent solution of ammonium hydroxide followed by a baking-out process for two hours at 250° F. Surface finish is inspected, blemishes are removed by fine sanding, and final inspection takes place. A light rust-proofing oil is next applied. Before being wrapped and shipped, the cams are given a final coating of heavy oil.

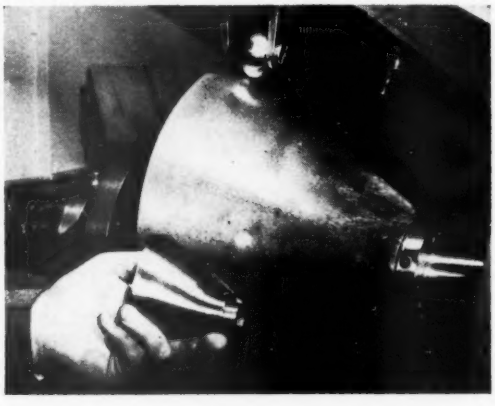


Fig. 2 Three-dimensional cam is precisely machined by Ford Instrument Company through a pantograph mechanism whose ball follower rides on an accurately-ground master cam.

IT'S NEW

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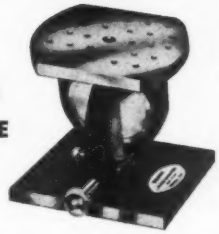

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Rotates 180° all directions
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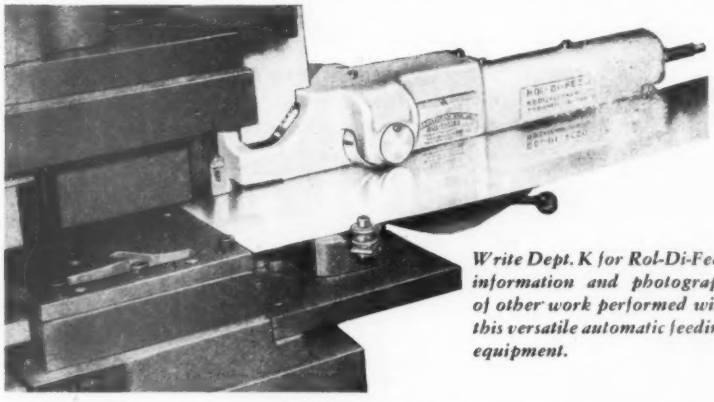
say Makers of the Dream Car

MATTEL, INCORPORATED of Los Angeles, "Toy Makers to His Majesty the Kid," has become in a few short years a foremost manufacturer of toys. Production and assembly techniques employ the latest methods and equipment. In the Metal Stamping Department, Dickerman Automatic Punch Press Feeds have long been used for their dependability and accuracy.

Says Mr. Dolfe Lee, Plant Engineer, "Feeding this wide, pre-chrome plated stock for the stamped parts of our Dream Car is a tough job. We can tolerate no marking or blemishes of any sort from the feeding operation, and the Rol-Di-Feed has met our exacting requirements in every way. We've increased production and reduced our labor cost. The Rol-Di-Feed is a Dreamboat."

You, too can benefit from the installation of Dickerman Automatic Punch Press Feeds in reduced parts cost per thousand and higher production. You may not feed mirror-finish stock, but whatever your feeding problem, one of our several models will solve it.



Write Dept. K for Rol-Di-Feed information and photograph of other work performed with this versatile automatic feeding equipment.

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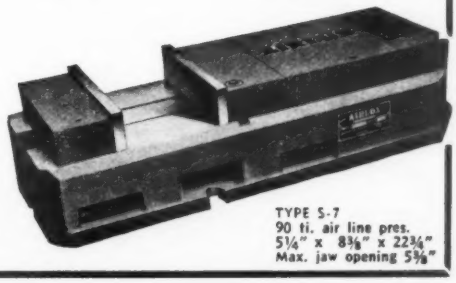

TYPE S-7
90 ti. air line pres.
5¼" x 8⅜" x 22¾"
Max. jaw opening 5⅜"

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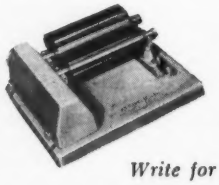
Announcing

the NEW 24 inch SPITFIRE FLAT LAPPING MACHINE

LOW COST PRECISION LAPPING AT PRODUCTION SPEED

A NEW, large size Flat Lapping Machine of improved design for precision lapping of any material where a perfectly flat surface is necessary. Extremely close tolerance finishes are possible. An ideal machine for producing mating surfaces of sliding and rotating parts of air and liquid tight seals, plastic and die casting molds.



SPITFIRE ROLLER LAPPING MACHINE

For lapping cylinders to accurate, mirror-like finishes in less time than any other method. Saves up to ⅔ time in lapping.

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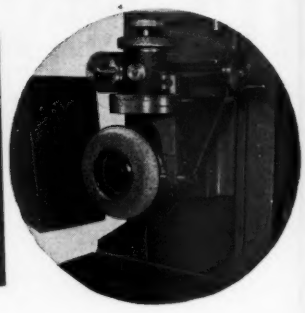
Radius Tangent WHEEL DRESSER

ELIMINATES Set-Up Time for Re-dressing



1. PERFECT DRESSING IN 30 SECONDS without moving work from chuck.
2. RE-DRESSING is SIMPLE . . . EXACT, no re-setting of dresser or work.
3. FOR PRECISION PRODUCTION on the No. 2 Surface grinder.
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6. COMPENSATES . . . SPINDLE to CHUCK error.

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STYLE A *for general boring*

STYLE B *for bottoming and facing*

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Bokum carbide-tipped boring tools are designed on a mathematical formula which guarantees the correct cutting and clearance angles throughout entire life of the carbide tip.

Clearances remain uniform throughout repeated resharpening.

The carbide inserts are brazed in special alloy steel heat-treated bodies having the same expansion and contraction qualities as the carbide tip. This prevents tip from cracking when it heats up.

A wide range of sizes is available for boring holes from 1/16" *diameter* up.

Send for Cat. 398-6 for complete information. And for supplement No. 1 to 398-6 for information about tools for jig borers put up in 16 sets of varied assortments. Tools for lathes in 8 sets of varied assortments.

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SINGLE POINT BORING TOOLS · INTERNAL THREADING, BOTTOMING AND FACING TOOLS · CARBIDE TIPPED TOOLS
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- CHOICE OF 5 HANDPIECE TYPES (all instantly interchangeable). You fit the handpiece to the job at hand.
- EXTRA GOOD FLEXING QUALITIES in the flexible shaft assembly for effortless maneuverability.
- LONGER MOTOR LIFE because motor is not dwarfed to fit the hand.
- HIGH SPEED (14000 RPM) which does not drop precipitately under load.
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Over 100,000 Foredoms Now In Use!

BENCH OR HANG UP MODELS FOR HEAVY OR LIGHT DUTY

Also flexible-shaft tools attachable to your own drill press or motor

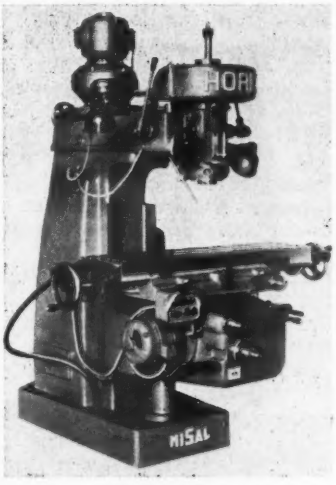
Use Foredoms to GRIND, POLISH, DRILL, ROUT, CARVE, MILL, SAW, SLOT, CLEAN, SAND, ETCH, ENGRAVE, etc., etc.

Write for Catalog 1761

FOREDOM Electric Co., Dept. 1761, 27 Park Place, N.Y. 7, N.Y.

3-D Duplicating Is Outstanding Feature On Milling Machine

Designed for tool room experimental work as well as light, higher precision production, the Horix high speed ram type vertical milling machine has accuracy combined with ability to produce smooth finishes and easy opera-

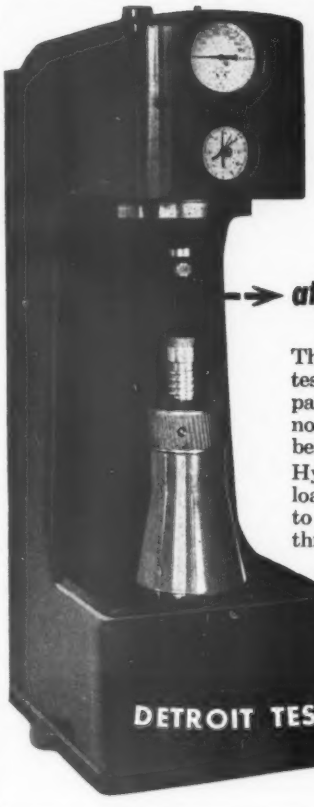


tion as its interesting features. Outstanding, however, is its capacity to do standard and three-dimensional duplications.

Operating to capacity, cutters up to 1½" diameter in steel and larger hard alloy cutters in soft materials are employed.

United Machinery and Sales Co., 2351 N. St. Louis Ave., Chicago 47, Ill. **Circle No. D3**

Brinell Testing



at production line speeds!

This direct reading Brinell hardness tester tests round or flat parts *fast*. No grinding of parts is necessary and the operator simply notes that the dial indicator needle falls between pre-set tolerance hands.

Hydraulically applied standard Brinell test loads are used. Foot control allows operator to test parts as quickly as he can move them through the machine.

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QUALITY CONTROL Calls For PRECISION FINISHES on CARBIDE TOOLS, DIES, ETC.

"MICRO MESH"
PURE DIAMOND LAPPING COMPOUND
WILL SOLVE YOUR
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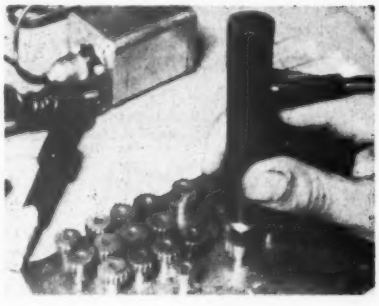

SAFE. No Acid Fumes to injure the finest parts or instruments.

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NO DISTORTION of even the thinnest sections.

PERMANENT MARKS. Do not rub off, wash off or peel off.

CLEAR LEGIBLE MARKS.

LECTROETCH — the PREFERRED INSPECTION SYSTEM now provides these added Advantages —

- CARTRIDGES loaded and tested at the factory. Always ready for Instant Use.
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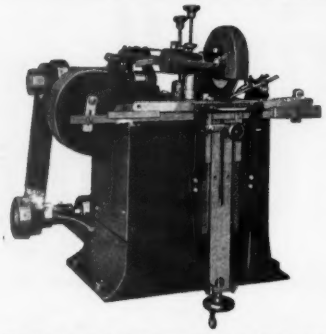
- A Demonstration will change your entire concept of Inspection Marking.

LECTROETCH enables you to CO-ORDINATE QUALITY, INSPECTION, PRODUCTION and SECURITY CONTROL at no additional cost. Call or write for details.

The LECTROETCH Co. East Cleveland 12, Ohio



Wardwell Model EC Combination Grinder. The only single unit grinder adaptable for hack, band and circular saws that does not depend on the shape of the grinding wheel to form the shape of the tooth. ● This unique feature enables operator to grind a variety of blades without dressing or changing wheels.

sharpening 1 gross of hack saw blades PAYS for this machine!

One gross of hack saw blades can be re-sharpened at least 6 times—actually saving you the price of the machine!

Wardwell EC Grinder gives old blades a keener, longer lasting cutting edge—because new blades are usually not ground after hardening.

Wardwell EC wheels will not burn, anneal or injure hardness of teeth. Sharpen Circular, Hack or Band Saw blades on one machine!

WRITE FOR BULLETIN EC TODAY

Complete Wardwell Catalog describing more than 30 grinding, sharpening, setting and swaging machines also available.

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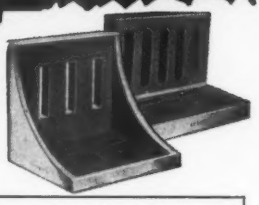
ECLIPSE ANGLE PLATES

Accurate . . . Rugged



Eclipse Angle Plates are available in "Webbed End" and "Open End" patterns. Made from high quality castings and seasoned before machining to prevent distortion. All faces of Open End and outside faces and edges of Webbed End patterns are machined square and parallel.

Webbed	Cost	Length	1st Angle	2nd Angle	Open End	Cost
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#200	3.25	3½"	3"	2½"	....	....
#201	4.25	4½"	3½"	3"	#301	$5.50
#202	5.50	6"	5"	4½"	#302	7.75
#203	7.00	7"	5½"	4½"	#303	9.25
#204	9.00	8"	6"	5"	#304	11.50
#205	11.50	9"	7"	6"	#305	14.50
#206	17.00	10"	8"	6"	#306	18.50
#207	22.00	12"	9"	8"	#307	24.00

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DEALERS IN TOOL ROOM EQUIPMENT
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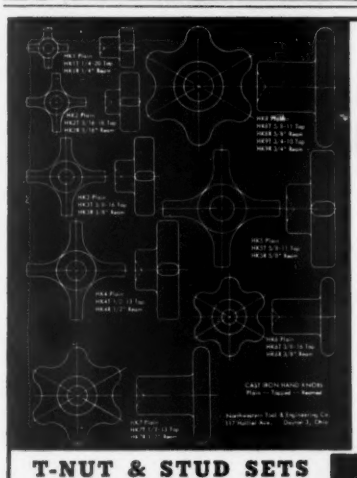

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T-NUT & STUD SETS
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PUNCH PRESS SETS

Northwestern
116 HOLLIER AVE., DAYTON 3, OHIO

Annual Westinghouse Talent Search

The annual quest for young men and women deemed most promising for future careers in science was begun recently as high school seniors throughout the nation were invited to compete in the thirteenth annual Science Talent Search.

The long trail, upon which entrants from public, private and denominational schools will start soon, will lead 40 finalists to Washington next spring for the Science Talent Institute. During the five-day affair they will compete for a total of $11,000 in Westinghouse Science Scholarships and will hear addresses by some of the nation's leading men of science.

Dr. Leonard Carmichael, secretary of the Smithsonian Institution and principal speaker at the 1953 Science Talent Institute, in a statement recently commented on the Search as follows: "For a number of years I have had something to do with the listing and classification of our nation's scientists. The manpower problem is far more critical than that of filling our need for armed service personnel. The Science Talent Search is an invaluable aid in helping boys and girls to select and be educated for their chosen fields in the world of science."

The boy or girl whose all-around performance as well as personal characteristics are judged the most outstanding, will receive the top $2,800 scholarship. Other scholarships ranging from $100 to $2,000 will be awarded to the remaining 39 finalists during the Institute, which is slated to begin February 25.

The scholarships are awarded by the Westinghouse Educational Foundation, which is supported by the Westinghouse Electric Corporation. The Search is conducted by Science Clubs of America, administered by Science Service.

Entrants Face Rugged Set of Requirements

In addition to the 40 Washington trip winners, 260 boys and girls who demonstrate "real promise of becoming creative scientists" will receive honorable mention citations.

. . . *Continued on page 201*

S&E Tungsten Carbide PLUG GAGES

REVERSIBLE TYPE

DIAMETERS .025 to .760 CLASSES XX, X, Y & Z

LONG LIFE: users report up to 50 times greater life than similar gages made of steel.

CUT CHECKING COSTS: Carbide gages eliminate frequent checking and provide material savings in checking costs.

LESS SCRAP: It is not necessary to add the usual wear allowance built into steel gages. This means fewer rejected parts due to "oversize" GO members.

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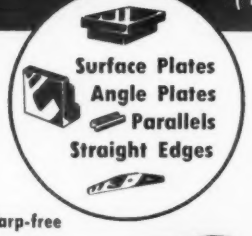

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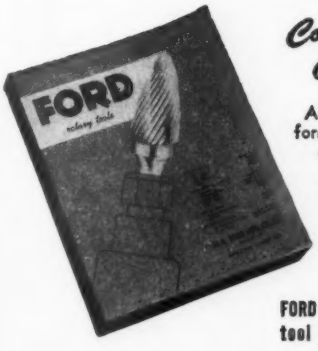

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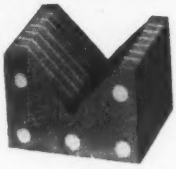

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Plunger moves away from, instead of against the lever, protecting delicate parts from sudden or excessive jolts. Each graduation on scale represents 1/1000" movement of plunger. $7.50 plus postage.

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Drawbolt has positive lock to prevent slippage. Spindle: 9"x5/16". Block: 3¼"x2½"x1" with 90° angle groove in base. Surface Gage is precision ground. $8.75 plus postage.

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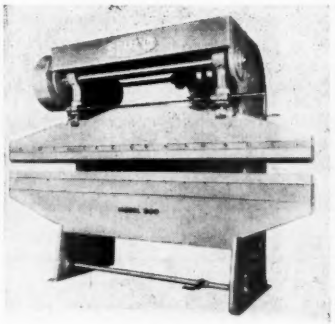
New Press Brake Is Announced By Service Machine

A new press brake that is being built in 6′ and 8′ sizes, having many advanced functional features, has been announced by Service Machine Co., Inc., 146-258 Miller St., Elizabeth, N. J.

The extra sturdy welded frame of this brake is normalized and then machined in one piece for accuracy. The forged alloy steel eccentric crank-shaft is one piece and the cast steel flywheel is perfectly balanced.

The press is built entirely around the principles of ease of operation, base adjustment, ample sturdiness and power and precision quality. Largely eliminated in the new SEMCO power press brake is the friction factor of operation.



Other new features are:

ACCURATE RAM and welded steel frame are both normalized.

ALLOY STEEL adjusting screws with buttress thread and revolving alloy bronze nuts designed not to jam.

PRECISION ADJUSTMENT of ram. (One complete revolution of operator handle adjusts only 0.125 inch).

BALANCED CAST steel flywheel runs on ball bearings.

MOVABLE PARTS have ball or roller bearings throughout with the exception of alloy bronze bearings on the alloy steel forged and balanced eccentric crankshaft.

ADJUSTABLE VARIABLE speed drive and 1½ hp motor.

FOOT TREADLE adjustable to any position of bed with uniform action at any point.

Additional details will be furnished by SEMCO upon request.

Circle Inform-A-Gram No. D4

. . . Talent Search, from page 198

The estimated 15,000 initial entrants face a rugged set of requirements. They report on an original science project and take a stiff aptitude examination. Their school will submit scholastic records and teachers' estimates of their ability and personal attributes. To be eligible, entries must be received in Washington by midnight, Sunday, December 27, it was explained by Watson Davis, director of Science Service.

The customary advanced nature of the projects carried out by the youthful entrants, who range in age from 15 to 18, was typified by last year's exhibits. Among these were: The building of a working model of a jet engine; the development of a new approach to the solution of a mathematical problem that has baffled scientists for more than 100 years; the construction—by two entrants—of Van de Graaff generators.

Since the Search began in 1942, more than 165,000 high school seniors have participated. More than 32,000 of these, including some 7,000 girls, have completed the rigorous final requirements. Westinghouse scholarships totaling $132,000 have been awarded to 364 boys and 116 girls, while 3120 have been named for honorable mention.

Offers of Other Aid Usual for Finalists, Citation-Winners

As in the past, it is expected that all finalists and honorable mention winners will receive offers of financial assistance for college educations from sources apart from the Westinghouse Scholarship Awards. It is estimated that a total of more than $1,500,000 in such assistance has been offered to entrants in the past 12 years.

Many of last year's finalists were employed during the past summer in industries and laboratories from coast-to-coast. Five spent the summer at the National Bureau of Standards in Washington, D. C. Ten had summer jobs with Westinghouse at Pittsburgh.

Twenty-five states and the District of Columbia are conducting their own science talent searches concurrently with the national competition this year. Thus many high school seniors will have a chance to win state scholarships after attempting the big prize—the national competition. These states are: Arkansas, Alabama, Connecticut, Georgia, Illinois, Indiana, Iowa, Kansas, Louisiana, Maine, Massachusetts, Michigan, Minnesota, Montana, New Hampshire, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Texas, Vermont, Virginia, West Virginia and Wisconsin.

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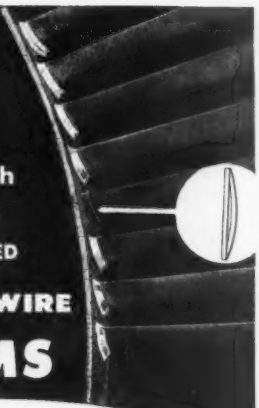

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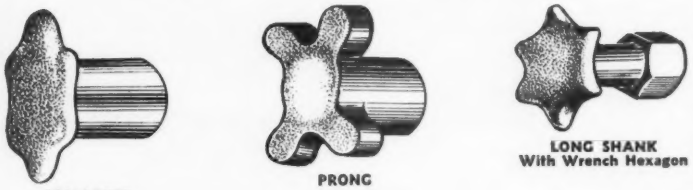

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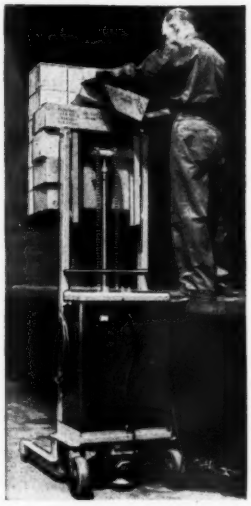
Battery-Operated Worklifter Has Safe Maximum Of 1,100 Lbs.

This new material handler, the Worklifter, lifts loads of 750 to 1000 lbs. to a height of 5 feet. It is made by the Economy Engineering Co., 4511 West Lake St., Chicago 24, Ill.

The worklifter is battery-operated and as such can be used almost anywhere at anytime. Two heavy-duty batteries, connected



in series, provide sufficient power for day-long continuous duty or several days of intermittent use.

The Worklifter has a maximum safe capacity of 1,100 lbs. Overall height is 6′ 6″, with lift operating from 5¼″ above floor to 5 feet. Baseframe of the lifter is 24″ wide and 39″ long overall. The platform consists of a 24″ square steel plate with a 17″ high backplate. The hoist unit is an electric-hydraulic gear-operated pump, giving constant flow to ram, with pushbutton control for precise raising and lowering of loads. The machine has a foot-operated type floor lock. **No. D5**

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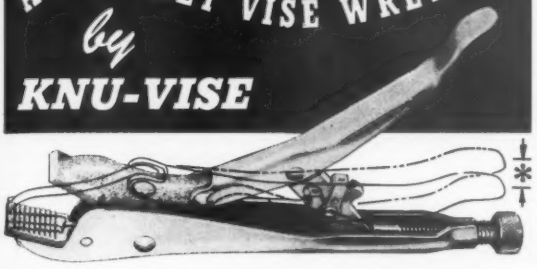

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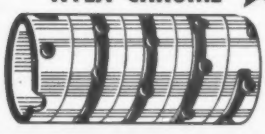

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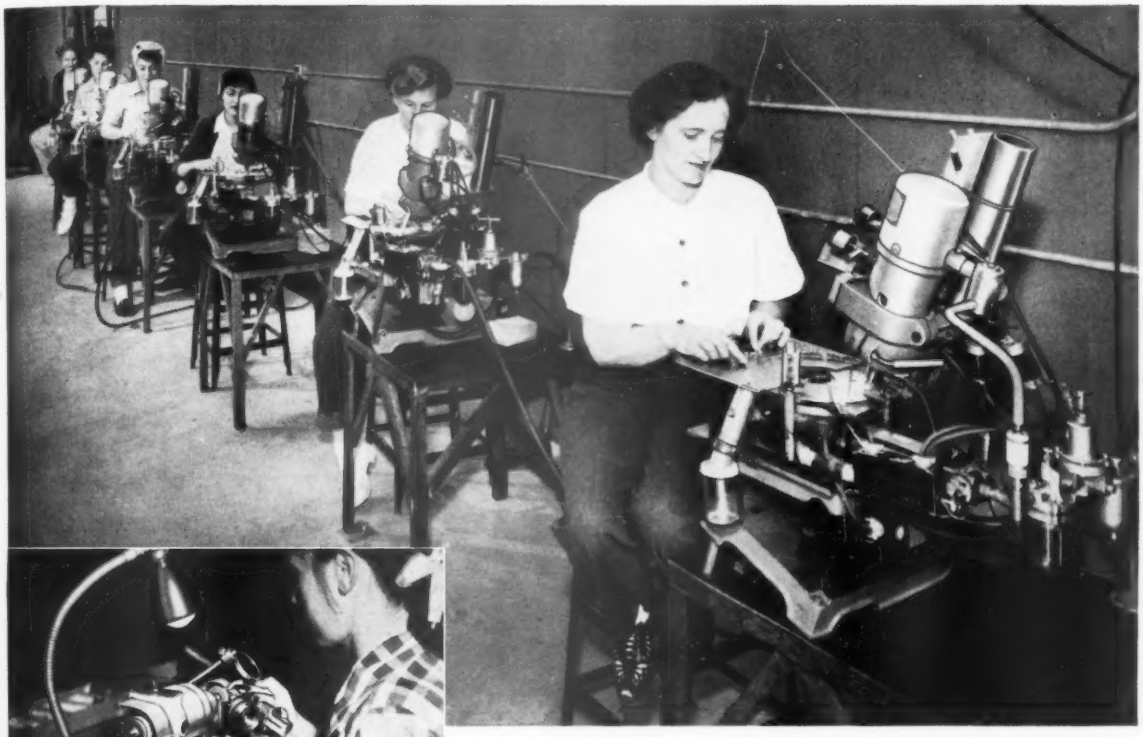
124,800 holes per day! ...using six DUMORE Automatic Drill Heads



A Dumore Precision Drill Grinder is used to sharpen drills after a full day's production. Maximum drill life per grind has reached 23,000 holes.

Parts are hand loaded in an automatic indexing rotary table with 24 stations. Peak production has reached 23,000 pieces.

Get amazing cost-reducing benefits with Dumore Tools

TALK about amazing production! One west-coast manufacturer uses six continuous running Dumore Automatic Drill Heads to drill tiny brass parts — 20,800 per head per day. The job calls for a No. 71 drill (dia. .026") and hole depth of .069". In addition to the amazingly high production, the user reports that the Dumore Automatic Drill Heads slash costs of drill breakage, down-time and scrap loss.

Amazing, too, are the results this company achieves using a Dumore Precision Drill Grinder to sharpen their drills for this job. They actually get a full day of continuous production for every Dumore sharpened drill, without stopping to regrind.

Get all the information about these tools — their capacity to increase small hole production — to eliminate operator guesswork — to provide completely automatic control. Ask your nearby industrial distributor for a demonstration, or write:

DUMORE PRECISION TOOLS

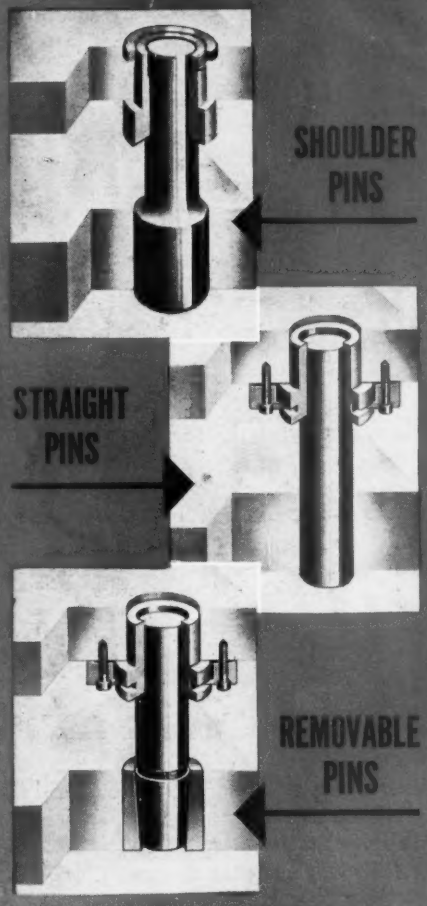
The Dumore Company

1313 Seventeeth Street • Racine, Wisconsin

for boosting die output—

and reducing maintenance

Lamina WATER-HARDENING STEEL GUIDE PINS



Lamina Guide Pins give exceptional service, too. Made of water-hardening tool steel and precision lapped on the O.D., these quality pins not only wear longer but perform better. They completely eliminate the brinelling and "mushrooming" characteristic of case hardened pins when they are driven into the shoe. Note, too, the improved design of the removable pins which simplifies installation.

DISTRIBUTORS: A few desirable territories are open to qualified distributors. If interested, please write for details.

PATENT PENDING

Lamina Guide Pin Bushings are hardened steel with bronze electroplated on the inside diameter . . . it's the one bushing design that gives you the long wear life of hardened steel with complete freedom from seizing and scoring. Added to the free-running qualities of the bronze bearing surface, a double figure-eight oil groove keeps the pin and bushing properly lubricated at all times.

Lamina Guide Bushings are made in two styles illustrated above and in a number of diameters and lengths. As shown at the left they can be used with straight, shoulder and removable type pins. For longer press runs with fewer shut-downs, specify Lamina Guide Pins and Bushings.

Lamina Dies and Tools, Inc., 14925 W. Eleven Mile Road, Berkley, Michigan.

This new brochure gives complete information and sizes on Lamina Guide Pins and Bushings. It also illustrates many other Lamina dies, tools and die-maker's equipment. Send for your copy, there is no obligation.

Lamina DIES AND TOOLS

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